BULLETIN OF MARINE SCIENCE, 60(3): 1074–1128, 1997

FIVE NEW SPECIES OF JAWFISHES (*OPISTOGNATHUS*: OPISTOGNATHIDAE) FROM THE WESTERN ATLANTIC OCEAN

William F. Smith-Vaniz

ABSTRACT

Synonymies, diagnoses, descriptions, illustrations, and spot distribution maps are given for ten species of *Opistognathus,* including all western Atlantic species that have a cirrus on their anterior nostrils. Three deep-water species lacking nasal cirri are also treated, including *O. leprocarus* n. sp. (Bahamas and Lesser Antilles), *O. melachasme* (Yucatan), and *O. nothus* n. sp. (North Carolina, Gulf of Mexico and Cuba); the latter two species were originally thought to represent different sexes of the same species. The *O. macrognathus* species group is diagnosed primarily by having sexually dimorphic jaws and sexually dichromatic maxillary markings, and includes the eastern Pacific *O. scops* and the following five western Atlantic species: *O. macrognathus* (Florida, Gulf of Mexico, and Bahamas to northern South America), *O. brasiliensis* n. sp. (southern Brazil), *O. cuverii* (southern Brazil), *O. robinsi* n. sp. (South Carolina, Florida, Bahamas, and Gulf of Mexico), and *O. signatus* n. sp. (Nicaragua, Panama, and northern South America). *Opistognathus robinsi* and *O. signatus* are very similar morphologically and here recognized as allopatric sister-species but the possibility exists that their disjunct continental distributions may be a collecting artifact. The broadly distributed and shallow-water species *Opistognathus whitehurstii* and *O. maxillosus* are superficially similar to some members of the *O. macrognathus* species group, including having cirri on their anterior nostrils, but differ most obviously in having non-sexually dimorphic jaws and more numerous cephalic sensory pores. An identification key is provided for all known western Atlantic species of *Opistognathus.*

Jawfishes are rather poorly known scientifically and their phylogenetic relationships are obscure. The family consists of three currently recognized genera, *Opistognathus, Lonchopisthus,* and *Stalix,* with about 60 described and 40 undescribed species. These benthic marine fishes occur in depths from about 0.3 to at least 375 m in most tropical seas but are absent from the Pacific Plate (except the islands of Belau and Samoa), eastern Atlantic Ocean, and Mediterranean Sea. No species occur on both sides of the isthmus of Panama, although some New World species have amphi-American relationships. Jawfishes are obligate burrow dwellers that orally incubate their eggs, a behavior apparently restricted to males (Hess, 1993). Limited dispersal capabilities combined with a high level of regional endemism make jawfishes potentially ideal subjects for biogeographic studies. The best known western Atlantic jawfish, *Opistognathus aurifrons,* is a popular aquarium species.

This paper is an outgrowth of ongoing revisionary studies. Prior to this study, 22 nominal species of western Atlantic jawfishes had been described, only 12 of which I consider to be valid (Table 1). At least seven additional species of *Opistognathus,* five of which are described herein, and one *Lonchopisthus* species currently lack scientific names, making a total of 20 western Atlantic species. In addition to three deep-water species, all western Atlantic species of *Opistognathus* with cirri on their anterior nostrils are treated, bringing to 10 the total number of species fully described in this paper.

One of the two new species of deep-water jawfishes described herein, *Opistognathus leprocarus,* was collected in the 1960s by the R/V OREGON at two stations in the Lesser Antilles and more recently by personnel associated with the

Table 1. List of nominal species of western Atlantic jawfishes. The following list gives in order: (1) the scientific name, as it originally appeared, in alphabetical order by species name; (2) the author or authors (Cuvier and Valenciennes is abbreviated C. & V.); (3) date of publication; and (4) present identification if changed (excluding names differing only in the spelling of *Opistognathus*). *Valid taxa are indicated by an asterisk.

Species, author, date	Present identification if changed
**Gnathypops aurifrons* Jordan and Thompson, 1905	*Opistognathus aurifrons* (Jordan and Thompson)
Gnathypops bermudezi Howell Rivero, 1936	
**Opistognathus brasiliensis* new species (this paper)	*Opistognathus aurifrons* (Jordan and Thompson)
Upsilonognathus chaplini Fowler, 1946	*Opistognathus whitehurstii* (Longley)
**Opisthognathus cuvierii* Valenciennes *in* C. & V., 1836	
Opisthognathus fasciatum Longley, 1940	*Opistognathus macrognathus* Poey
**Opistognathus gilberti* Böhlke, 1967	
**Lonchopisthus higmani* Mead, 1959	
Lonchistium lemur Myers, 1935	*Lonchopisthus lemur* (Myers)
**Opistognathus leprocarus* new species (this paper)	
**Lonchopisthus lindneri* Ginsburg, 1942	*Lonchopisthus micrognathus* (Poey)
**Opisthognathus lonchurus* Jordan and Gilbert, 1882	
**Opisthognathus macrognathus* Poey, 1860	
Opisthognathus macrops Poey, 1860	*Opistognathus macrognathus* Poey
**Opisthognathus maxillosus* Poey, 1860	
Lonchopisthus meadi Menezes and de Figueiredo, 1971	*Lonchopisthus lemur* (Myers)
**Opistognathus megalepis* Smith-Vaniz, 1972	
Opisthognathus megastoma Günther, 1860	*Opistognathus macrognathus* Poey
**Opistognathus melachasme* Smith-Vaniz, 1972	
**Opisthognathus micrognathus* Poey, 1860	*Lonchopisthus micrognathus* (Poey)
Gnathypops mystacinus Jordan, 1884	*Opistognathus lonchurus* Jordan and Gilbert
**Opistognathus nothus* new species (this paper)	
**Opistognathus robinsi* new species (this paper)	
Opistognathus scaphiurus Goode and Bean, 1882	*Opistognathus macrognathus* (Poey)
**Opistognathus signatus* new species (this paper)	
Lonchopisthus vanderbilti Mowbray *in* Borodin, 1928	*Lonchopisthus micrognathus* (Poey)
**Gnathypops whitehurstii* Longley, 1931	*Opistognathus whitehurstii* (Longley)

Harbor Branch Foundation during a series of submersible dives off San Salvador Island, Bahamas. The latter material was brought to my attention by R. Grant Gilmore, who also generously made available his beautiful color illustration (Fig. 1) of this species. As he and C. Richard Robins are currently preparing a paper on San Salvador fishes observed or collected during submersible dives, I take this opportunity to describe this distinctive species.

I also redescribe *Opistognathus melachasme,* a spectacular deep-water jawfish with an enormous upper jaw, known from one adult male and a small juvenile taken in separate trawl collections on Arrowsmith Bank off the Yucatan Peninsula. A gravid female, collected subsequently from off North Carolina and identified as *O. melachasme,* led Anderson and Smith-Vaniz (1976) to report what they believed to be a remarkable degree of sexual dimorphism exhibited by the species. Additional specimens from the Gulf of Mexico and re-examination of the original material has revealed that the non-Yucatan specimens represent a different, closely related new species, described herein as *Opistognathus nothus.*

This festschrift volume is an especially appropriate place to describe the "spot-fin jawfish," *Opistognathus robinsi,* which has been widely recognized in the literature as an undescribed species (Robins et al., 1980; Robins and Ray, 1986). Five western Atlantic jawfishes, *O. robinsi, O. macrognathus, O. brasiliensis* n. sp., *O. cuvierii,* and *O. signatus* n. sp., and the eastern Pacific *O. scops,* all have sexually dimorphic jaws and sexually dichromatic maxillary markings and appear to comprise a monophyletic clade. The five western Atlantic species are described in the text and their diagnostic characters compared in Table 8.

New World jawfishes are currently classified in two genera, *Opistognathus* Cuvier and *Lonchopisthus* Poey. *Lonchopisthus* is distinguished from *Opistognathus* in having a lanceolate caudal fin and the bony maxilla strongly notched or hooked posteroventrally in adults. I consider *Lonchopisthus* to be monophyletic, but there is no known apomorphy that defines *Opistognathus,* which may be polyphyletic. Until a cladistic analysis of the Opistognathidae becomes practical, I continue to treat *Opistognathus* in its traditional sense, based, in part, on the following observations. A non-elongate maxilla, which is characteristic of most opistognathids, is considered to be a plesiomorphic character state for the family. Meek and Hildebrand (1928:900) were the first authors to note that several New World jawfishes have sexually dimorphic jaws. In species with sexually dimorphic jaws, the maxilla is posteriorly truncate and somewhat rigid in juveniles, and in adults the maxilla has a thin, flexible lamina that in mature females is only slightly elongate and in males very elongate (Figs. 14a–b). The degree of jaw elongation is variable ranging from very slight to greatly elongate in Indo-Pacific species with elongate jaws, but the jaws are not sexually dimorphic and inner maxillary markings, if present, are not dichromatic. In *Opistognathus nigromarginatus* Cuvier, (type species of *Opistognathus*), both sexes have very elongate maxillae. *Gnathypops* Gill (type species *Opistognathus maxillosus*) has sometimes been assigned to jawfishes with the posterior end of the maxilla rigid and relatively truncate, but I consider the name to be a synonym of *Opistognathus.*

Methods and Materials

Counts and measurements follow those described by Hubbs and Lagler (1958) except as noted below. Counts of the rays of the median fins and characters associated with the vertebral column were taken from radiographs. The last two elements in the dorsal and anal fins have their bases in close approximation ("split to base" condition) and were counted as one ray in accordance with the general practice of most authors, although the ultimate element is associated with a separate element, a rudimentary stay. Procurrent and segmented caudal-fin rays are reported as a two-part formula, with

Figure 1. *Opistognathus leprocarus*, USNM 258668, 60.1 mm SL, male, Bahamas, San Salvador, off Green Cay (illustration by R. Grant Gilmore).

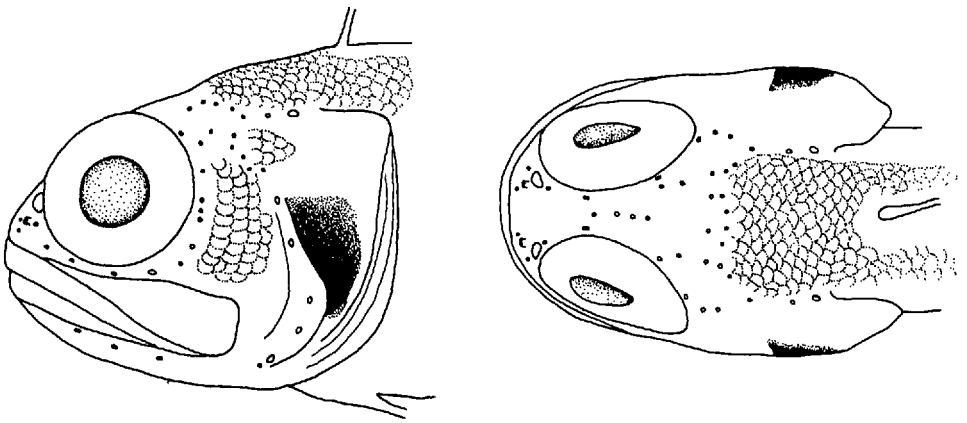

Figure 2. Physiognomy of head and cephalic sensory pores (lateral line pores not shown) in *Opistognathus leprocarus,* IRCZM 107:07802, 61.2 mm SL, male, Bahamas.

rays associated with the dorsal hypural given first followed by those of the ventral hypural. The lateral-line terminus refers to the base of the posteriormost segmented dorsal-fin ray below which the lateral line ends; a fractional number was used when the lateral-line terminus ended between the bases of two rays. The short, dorsalmost spine-like element in the pectoral fin is included in the ray counts. The number of oblique scale rows are often difficult to count because of the irregular size and arrangement of individual scales. Included in this count are all anteroventrally aligned scale rows in a longitudinal series from above the tip of the opercular flap to the base of the caudal fin (counts of posteroventrally aligned scale rows result in lower values). Scale counts are often only approximations, but are useful, nevertheless, in distinguishing species. The gill raker at the junction of the upper and lower limbs of the first gill arch is included in the lower-limb count.

Measurements were made with needlepoint dial calipers and recorded to the nearest 0.1 mm. Head length is taken from the middle of the upper lip to the posterodorsal tip of the opercular flap. Orbit diameter is a diagonal (posterodorsal to anteroventral) measurement of the bony orbit; the posterodorsal point of origin is the rigid sphenotic margin. Body depth is a vertical measurement from the origin of the anal fin. Caudal peduncle depth is the least vertical measurement of the caudal peduncle. Dorsal-fin spines were measured from their anterior angles of insertion to their distal tips, or the margin of the fin if the spine was strongly curved distally.

Regression slopes of orbit diameters of *Opistognathus robinsi* and *O. signatus* were compared using an F test to determine whether the reduction in residual sum of squares associated with linear models of two slopes versus one slope was statistically significant ($P < 0.05$).

Institutional abbreviations follow Leviton et al. (1985). The majority of specimens used for this study were formerly part of the University of Miami, Rosensteil School of Marine and Atmospheric Sciences Ichthyological Collection (UMML), which was recently transferred to the Florida Museum of Natural Sciences, Gainesville (UF); some of these specimens had previously been reassigned ANSP catalog numbers, and others are identifiable by their UF 200,000 series catalog numbers. In material examined, cleared and stained specimens are indicated as C&S. Collection data are usually abbreviated.

Opistognathus leprocarus new species
Figures 1–3, 8a; Tables 2–6

Opistognathus sp. Smith-Vaniz and Böhlke, 1991:198 (listed from Bahamas; common name "rough-cheek jawfish").

Diagnosis.—A species of *Opistognathus* distinguished from all others by the following combination of characters: anterior nostril a short tube without cirrus on posterior rim; posterior end of maxilla rigid, without thin flexible lamina; opercle with prominent wedge-shaped dark blotch; buccal cavity and inner lining of maxilla and adjacent membranes immaculate; dorsal-fin spines slender, straight, with rigid sharp tips; nape completely scaled; cheeks with 4 or 5 rows of scales; segmented anal-fin rays 11 or 12; caudal vertebrae 16; pelvic fins very elongate, in

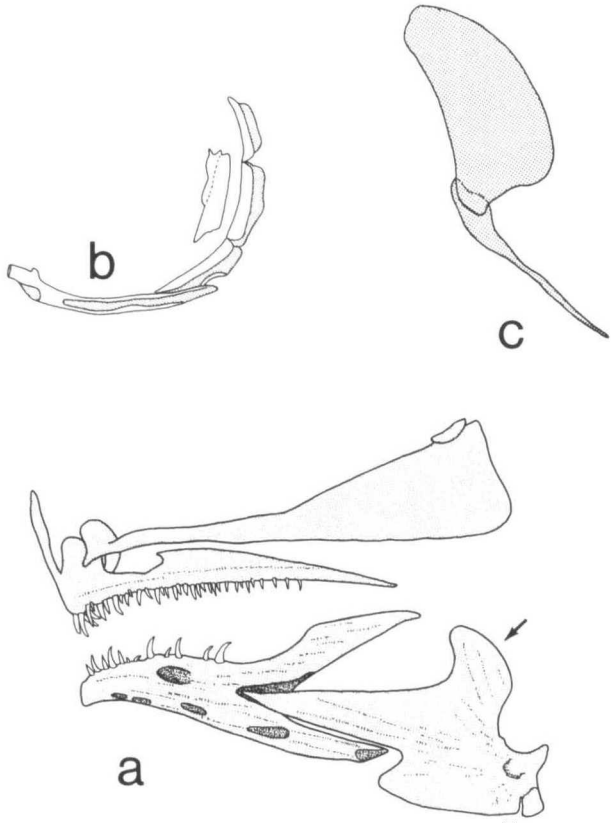

Figure 3. Selected bones in lateral views of *Opistognathus leprocarus*, ANSP 138563, 45.7 mm SL: a, upper and lower jaws (small arrow indicates coronoid process of articular); b, infraorbital bones (3rd infraorbital also in rotated dorsal view); c, dorsal and ventral postcleithra.

adults 39–49% SL with tip of depressed fin extending posteriorly well past anal-fin origin.

Description.—Dorsal fin X or XI (rarely X), 11–13 = 22 or 23 total. Anal fin III, 11 or 12 (rarely 12). Pectoral-fin rays 19–22. Caudal fin: procurrent rays 4–5+4–5, segmented rays 8 + 8, middle 12 branched, total elements 24–26; hypural 5 present. Vertebrae: 10 + 16; last pleural rib on vertebra 10; epineurals 12 or 13. Supraneural bones 2, both very small. Gill rakers (not increasing with increase in SL) 16–18 + 30–35 = 46–53.

Nape, pectoral-fin base, breast, and belly completely scaled; cheeks with 3 or 4 scale rows and patch of scales on anterodorsal region of opercle. Body with 38–44 oblique scale rows in longitudinal series. Lateral-line terminus below verticals from bases of 2nd to 5th segmented dorsal-fin rays. Anterior lateral-line pores relatively sparse, arranged in unbranched series, positioned very close to embedded lateral-line tubes; lateral-line tubes embedded in skin posteriorly and on dorsal surface of anterior scales. Mandibulo-preopercular pore positions mostly consisting of single pores, except 4th and 5th mandibular pore positions occupied by 1or 2 and 2 or 3 pores, respectively; infraorbital pores all in single series (Fig. 2).

Anterior nostril distinctly closer to posterior nostril than to dorsal margin of upper lip, consisting of short tube without cirrus; height of nostril about 0.3 times

Table 2. Frequency distributions for numbers of dorsal-, anal-, and total pectoral-fin rays (both sides) in selected western Atlantic species of *Opistognathus* (holotype values in bold)

	Dorsal-fin spines			Segmented dorsal-fin rays									Total dorsal-fin elements								
Species	X	XI	XII	11	12	13	14	15	16	17	18	$\bar{x}$	22	23	24	25	26	27	28	29	$\bar{x}$
leprocarus	1	**9**		**4**	5	1						11.7	**4**	6							22.6
melachasme	**2**					1	**1**					13.5		1	**1**						23.5
nothus	**4**						**4**					14.0			**4**						24.0
whitehurstii	5	131	1			7	120	10				14.0			9	120	8				25.0
maxillosus	5	168					13	154	8			15.0			1	17	150	7			25.9
macrognathus	1	72	1					6	65	3		16.0					22	51	—	1	26.7
brasiliensis		**5**							**5**			16.0						**5**			27.0
cuvierii		**5**							**5**			16.0						**5**			27.0
robinsi	1	**103**						1	8	**92**	3	16.9					1	8	**93**	2	27.9
signatus	1	**14**							2	**13**		16.9						3	**12**		27.8

	Anal-fin spines		Segmented anal-fin rays									Total pectoral-fin rays										
Species	II	III	11	12	13	14	15	16	17	18	$\bar{x}$	35	36	37	38	39	40	41	42	43	44	$\bar{x}$
leprocarus		**10**	**9**	1							11.1					1	6	**1**	2			40.4
melachasme	**2**			1	**1**						12.5						**1**	—	—	—	1	42.0
nothus	**4**				**4**						13.0						**2**	—	1			40.7
whitehurstii		139		1	122	16					13.1	4	42	27	52	4	1					37.1
maxillosus	4	171				38	135	2			14.8					1	27	21	105	6	9	41.7
macrognathus	1	73					24	50			15.7				15	9	44	4	1	—	1	39.6
brasiliensis		**5**					**1**	4			15.8			**1**	4							37.8
cuvierii		**5**						**5**			16.0			**2**	3							37.6
robinsi	4	**100**						6	**91**	7	17.0		**1**	3	46	16	**24**	7	7			39.0
signatus	3	**12**						3	**12**		16.8				1	1	**11**	2				39.9

Table 3. Frequency distributions for numbers of procurrent caudal-fin rays, caudal vertebrae, and lateral-line terminus position in selected western Atlantic species of *Opistognathus* (holotype values in bold)

	Procurrent caudal-fin rays							Caudal vertebrae						
Species	5	6	7	8	9	10	$\bar{x}$	16	17	18	19	20	21	$\bar{x}$
leprocarus	**3**			1	**6**	3	9.2	**10**						16.0
melachasme			**2**				7.0			**2**				18.0
nothus	**3**						5.0			**4**				18.0
whitehurstii			16	22	97		8.6	2	133	3				17.0
maxillosus				32	117	6	8.8		3	157	4			18.0
macrognathus			14	35	16		8.0			3	61	3		19.0
brasiliensis			1	**1**	3		8.4			**5**				18.0
cuvierii	**3**	2					5.4				**5**			19.0
robinsi		**34**	51	4			6.7				6	**87**	1	19.9
signatus		10	**5**				6.3				3	**12**		19.8

	Lateral-line terminus relative to posteriormost, segmented dorsal-fin ray base below which lateral line ends (fractional numbers indicate intermediate positions)														
Species	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7.0	$\bar{x}$
leprocarus		—	—	**2**	—	—	1	2	1	3					3.9
melachasme								1	—	—	**1**				4.8
nothus				1	—	—	1	**1**							3.2
whitehurstii	4	14	8	35	18	23	3	3							2.2
maxillosus						1	2	13	6	59	27	45	4	5	5.3
macrognathus					3	5	11	21	8	8	1	2	1		4.1
brasiliensis					1	—	**1**	3							3.6
cuvierii				**5**											2.0
robinsi		6	7	25	**16**	27	7	5	—	2					2.5
signatus		1	**4**	5	4	1									2.0

maximum diameter of posterior nostril. Dorsal fin moderately high anteriorly, with posterior rays slightly longer; profile relatively straight without change in fin height at junction of spinous and segmented rays; dorsal-fin spines slender and straight with rigid sharp tips, first 1–3 segmented rays unbranched, others branched; first 1 or 2 segmented anal-fin rays usually unbranched, others branched. Outermost segmented pelvic-fin ray closely bound to adjacent ray, with interradial membrane weakly incised distally; pelvic fin very elongate in adults, tip of depressed fin extending posteriorly well past anal-fin origin; in 8 adults (61.2–81.2 mm SL) pelvic fin 38.9–49.1% SL $\bar{x}$ 43.0 versus 14.9% in 45.7 mm SL juvenile. Upper margin of subopercle slightly rounded posterodorsally, not consisting of broad truncated flap; dorsalmost spine of opercle not noticeably elongate; posterior margin of preopercle distinct, with well developed fleshy flap. No papillae on inner surface of lips. Fifth cranial nerve passes under A1β section of adductor mandibulae muscle.

Upper jaw not sexually dimorphic, extending 0.2–0.4 eye diameters behind orbit; posterior end of maxilla truncate, rigid, without thin flexible lamina; supramaxilla relatively small, terminally positioned (Fig. 3a). Coronoid (ascending) process of articular tilted slightly forward and bluntly rounded. Premaxilla outer-row teeth stout, becoming progessively smaller posteriorly, with some posteriormost teeth recurved medially; anteriorly, 1–3 inner teeth enlarged, strongly hooked backward. Dentary outer-row teeth stout, anteriorly teeth slightly recurved, posteriorly becoming larger and strongly recurved medially; inner row teeth restricted to anterior third of dentary, some strongly canted inward. Vomer with 0–3 large teeth. Infraorbital bones unroofed, trough-like (Fig. 3b); third infraorbital with very slight suborbital shelf. Postcleithra closely attached to each

Table 4. Frequency distributions of oblique body scale rows in selected western Atlantic species of *Opistognathus* (*holotype values)

Species	Number of scale rows																																
	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68		
leprocarus[1]	2	—	2	2*	5	3	2*																										
melachasme[1]											1*	—	—	1*																		
nothus[1]							1	—	—	1*	—	—	2*																				
whitehurstii					2	—	6	4	5	10	12	10	3	3	1																		
maxillosus																																	
macrognathus																																	
brasiliensis[1]																						2	1	—	—	1	1	—	—	2	—		
cuvierii[1]																							1*	—	—	—	1	—	1	2*	—		
robinsi																																	
signatus																				1*	1	—	3	—	1	3	—	1	2	—	—		

Species	Number of scale rows (continued)																										N	Range	$\bar{x}$	SD
	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95				
leprocarus[1]																												16	38–44	41.6	1.82
melachasme[1]																												2	48–51	49.5	—
nothus[1]																												4	44–50	47.8	2.87
whitehurstii																												56	42–52	47.3	2.20
maxillosus	1	—	4	1	6	6	4	6	5	2	5	5	—	4	2	3	2											56	69–85	77.1	4.05
macrognathus								1	—	—	2	3	3	4	3	3	4	2	3	2	1	2	1	1	—	—	1	36	76–95	84.5	4.14
brasiliensis[1]	—	—	1	1	—	—	1																					10	59–75	65.7	5.68
cuvierii[1]	1	—	1	1																								8	60–72	67.0	3.85
robinsi					1	3	3	6	1	8	6*	8	3	1	4	2	2	3	—	1								52	73–88	79.5	3.59
signatus	—	3																										15	57–70	63.5	4.26

[1] Bilateral counts each of: 8 specimens (*leprocarus*); 1 specimen (*melachasme*); 2 specimens (*nothus*); 5 specimens (*brasiliensis*); 4 specimens (*cuvierii*).

Table 5. Frequency distributions for numbers of vomerine teeth in selected western Atlantic species of *Opistognathus* (SL classes in mm; holotype values in bold)

Species	0	1	2	3	4	5	$\bar{x}$
leprocarus							
(46–59.9)	1	1					0.5
(≥60)	1	2	**4**	1			1.6
melachasme and *nothus*							
(31–79)	**6**						0
whitehurstii							
(25–39.9)	—	29	33				1.5
(40–59.9)	1	50	19	1			1.3
maxillosus							
(25–39.9)	—	11	9	1			1.5
(40–59.9)	1	18	13				1.4
(60–79.9)	2	30	6				1.2
(≥80)	4	55	8				1.1
macrognathus							
(25–39.9)	—	7					1.0
(40–59.9)	—	15	5				1.3
(60–79.9)	—	6	1				1.1
(≥80)	—	27	11				1.3
brasiliensis							
(≥80)	—	1	2	**2**			2.2
cuvierii							
(≥80)	—	—	**5**				2.0
robinsi							
(25–39.9)	—	7	4	1			1.5
(40–59.9)	—	9	6				1.4
(60–79.9)	—	4	11	4			2.0
(≥80)	—	**14**	30	8	6	1	2.2
signatus							
(40–59.9)	—	2	1				1.3
(60–79.9)	—	7	1				1.1
(≥80)	—	**3**	1				1.3

other (Fig. 3c); dorsal postcleithrum an irregular elongate oval, narrowest ventrally where it overlaps ventral postcleithrum; ventral postcleithrum club-shaped, broadest dorsally, with pointed ventral end.

Coloration.—In preservation, dark opercular wedge most obvious marking; spinous dorsal fin occasionally with narrow, dark, submarginal stripe, dorsal and anal fins with irregular pale blotches proximally; ground color of head and body light tan; inner maxillary and buccal pigmentation absent.

Life colors, based on notes and color illustration (Fig. 1) made by R. Grant Gilmore of a fresh caught specimen: Opercle with conspicuous brown-black wedge extending along posterior margin of preopercle; wedge accentuated by white preopercular and opercular margins, branchiostegal membranes, and pectoral-fin base. Iris with concentric rings of golden-yellow bordered by outer greenish-blue margin. Interorbit and nape blue-lavender; orbit narrowly ringed by same color. Ground color from orbit to caudal peduncle bright yellow. Sides of body with three broken, blue-lavender stripes, ventralmost poorly developed. Dorsum

Table 6. Morphometric data, expressed as percentages of standard length or head length (*), for 10 type specimens of *Opistognathus leprocarus*; values for holotype in parentheses

	Range	$\bar{x}$	SD
Standard length (mm)	45.7–81.2 (80.4)	67.9	12.2
Predorsal length	32.0–37.7 (34.5)	35.2	1.5
Preanal length	53.7–65.0 (57.0)	58.7	3.0
Dorsal-fin base	54.3–66.1 (60.0)	59.9	3.7
Anal-fin base	29.0–33.4 (33.0)	31.5	1.3
Pelvic fin length[1]	38.9–49.1 (49.1)	43.0	3.8
Caudal fin length	29.0–34.4 (31.2)	31.9	1.7
Depth anal-fin origin	25.2–28.3 (27.9)	26.7	1.0
Caudal peduncle depth	12.2–15.7 (14.8)	14.3	0.9
Length 5th dorsal spine	15.0–16.8 (15.2)	15.7	0.5
Length 5th dorsal ray	23.6–27.7 (26.5)	25.9	1.4
Head length	35.4–41.4 (37.4)	38.0	1.9
Postorbital head length	17.2–20.5 (19.2)	18.6	0.9
Orbit diameter	12.4–15.6 (13.7)	14.5	1.0
Upper jaw length	21.2–26.7 (21.8)	22.8	1.8
*Postorbital head length	46.6–51.2 (51.2)	49.0	1.4
*Orbit diameter	35.1–40.0 (36.5)	38.1	1.5
*Upper jaw length	55.1–66.4 (58.1)	60.0	3.6
*Postorbital jaw length	6.3–17.1 (14.0)	12.1	3.7

[1] Data for 8 specimens 61.2–81.2 mm SL; pelvic fin 14.9% SL in 45.7 mm SL juvenile.

with 4 or 5 broad yellow blotches extending onto dorsal fin; blotches separated by narrow, blue-lavender bands connected ventrally with dorsalmost body stripe, and dorsally to broad, blue stripe extending along mid-level of dorsal fin; blue stripe widens posteriorly, extending almost to distal margins of last 5 or 6 rays, and bordered above anteriorly by pale yellow stripe with narrow blue margin; yellow stripe replaced posteriorly by a few yellow spots. Dorsal fin with narrow, white dorsal margin. Anal fin with basal yellow stripe bordered below first by lavender stripe, then by wider, yellow stripe containing row of small, blue spots (each centered on a segmented rays); then remainder of fin (approximately distal half) blue-lavender. Caudal fin yellow basally with majority of fin blue, becoming darker distally. Pelvic fins brilliant white; pectoral fins colorless.

Etymology.—The trival name is derived from the Greek *lepros* (scaly) and *kara* (head), in reference to the well developed cephalic squamation. The recommended common name is roughcheek jawfish following Smith-Vaniz and Böhlke (1991).

Comparisons.—*Opistognathus megalepis,* another deep-water species, agrees with *O. leprocarus* in fin ray and vertebral counts and in having a scaled nape and (usually) cheeks, but lacks a distinctive color pattern and has slender flexible dorsal-fin spines without rigid, sharp tips.

Remarks.—When approached by a submersible, individuals of *Opistognathus leprocarus* were observed using shells and rubble to close their burrow opening (G. Gilmore, pers. comm.); Colin (1972) reported similar behavior in *O. aurifrons,* where it serves as an anti-predator defense mechanism when the jawfish is inactive in its burrow at night.

Distribution (Fig. 4).—Known only from the Bahamas and the Lesser Antilles in depths of 165–308 m.

Material Examined.—10 specimens, 45.7–81.2 mm SL. Holotype: ANSP 151615 [formerly IRCZM 107:7205], male, 80.4 mm SL, Bahamas, San Salvador, off Riding Rock Point, 24°04'N, 74°33'W, 308 m, JOHNSON-SEA LINK I (JSL-I), Dive 1294, 19 Oct 1982. Paratypes: BAHAMAS: San Salvador:

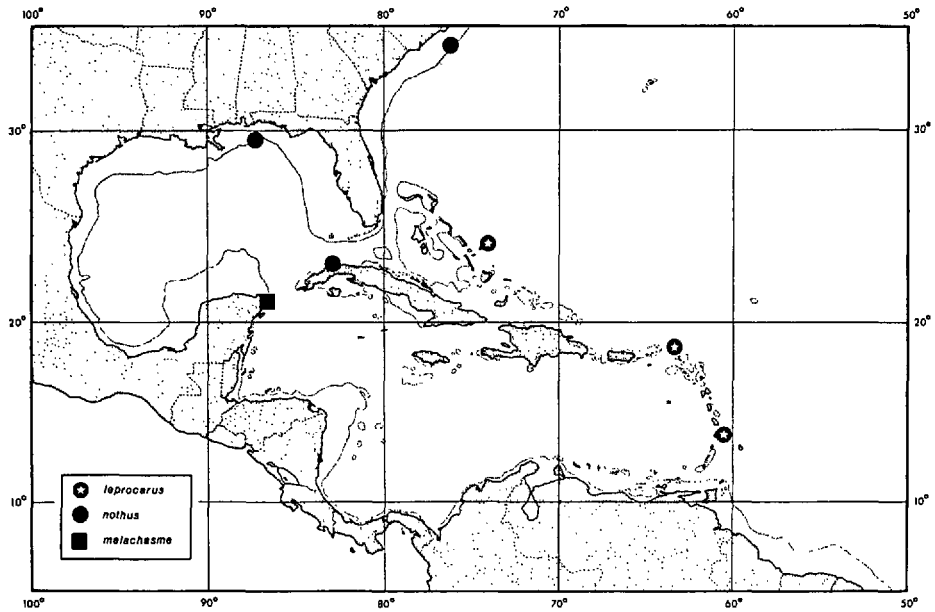

Figure 4. Distributions of *Opistognathus leprocarus, O. melachasme* and *O. nothus.*

ANSP 153335 (1, 72.0), off Riding Rock Point, 24°03.5'N, 74°32.5'W, 275 m, JSL-I Dive 1508, 29 Oct 1983; ANSP 159269 (1, 53.5, C&S), 24°05'52"N, 74°32'21"W, 292 m, JSL-I Dive 2021, 1 May 1987; ANSP 163460 (1, 81.2), male brooding egg mass, off Cockburn Town, 24°03'30"N, 74°33'24"W, 300–379 m, JSL-I Dive 2012, 27 Apr 1987; UF 40690 (1, 77.7), Fernandez Bay, 24°01.1'N, 74°32.5'W, 249 m, JSL-I Dive 1511, 30 Oct 1983; USNM 258668 (1, 60.1), off Green Cay, 24°08.5'N, 74°31'W, 308 m, JSL-I Dive 1288, 16 Oct 1982; ANSP 159270 (1, 70.7), gravid female, and IRCZM 107: 07802 (61.2), 24°08'40"N, 74°25'53"W, 268 m, JSL-I Dive 2018, 30 Apr 1987. LESSER ANTILLES: ANSP 138163 (1, 76.6), off St. Lucia, 13°41'N, 60°53'W, 165 m, 10 Mar 1966, R/V OREGON sta 5955; ANSP 138563 (1, 45.7, C&S), Anegada Passage between Virgin Is. and Anguilla, 18°36'N, 63°27'W, 201–238 m, 30 Apr 1967, R/V OREGON sta 6715.

Opistognathus melachasme Smith-Vaniz, 1972
Figures 5, 6a, 7a1–2, 8b, 9a; Tables 2–5, 7

Opistognathus melachasme Smith-Vaniz, 1972:50, figs. 3–4 (orig. descr.: Arrowsmith Bank off Yucatan, 21°07'N, 86°21'W; holotype ANSP 114763); Robins and Ray, 1986:217, color pl. 43 (brief desc.; distrib., mostly applies to *O nothus*).

Diagnosis.—A species of *Opistognathus* distinguished from all others by the following combination of characters: anterior nostril a short tube without cirrus on posterior rim; posterior end of maxilla produced as a thin flexible lamina that, in adult males, extends to posterior margin of opercle; coronoid process of articular club-shaped with dorsal margin smoothly convex; vomer edentate; inner lining of maxilla and adjacent membranes with a conspicuous black stripe; spinous dorsal fin with a prominent ocellus; segmented dorsal- and anal-fin rays 13 or 14 and 12 or 13, respectively; caudal vertebrae 18.

Description.—Dorsal fin X, 13 or 14. Anal fin II, 12 or 13. Pectoral-fin rays 20 or 22. Caudal fin: procurrent rays 4+3, segmented rays 8+8, middle 12 or 14 branched; hypural 5 present. Vertebrae: 10 + 18, last pleural rib on vertebra 10, epineurals 13 or 14. Supraneural bones absent. Gill rakers 7–9 + 20–21 = 27–30.

Scales absent from head, nape, pectoral-fin base and breast; belly completely

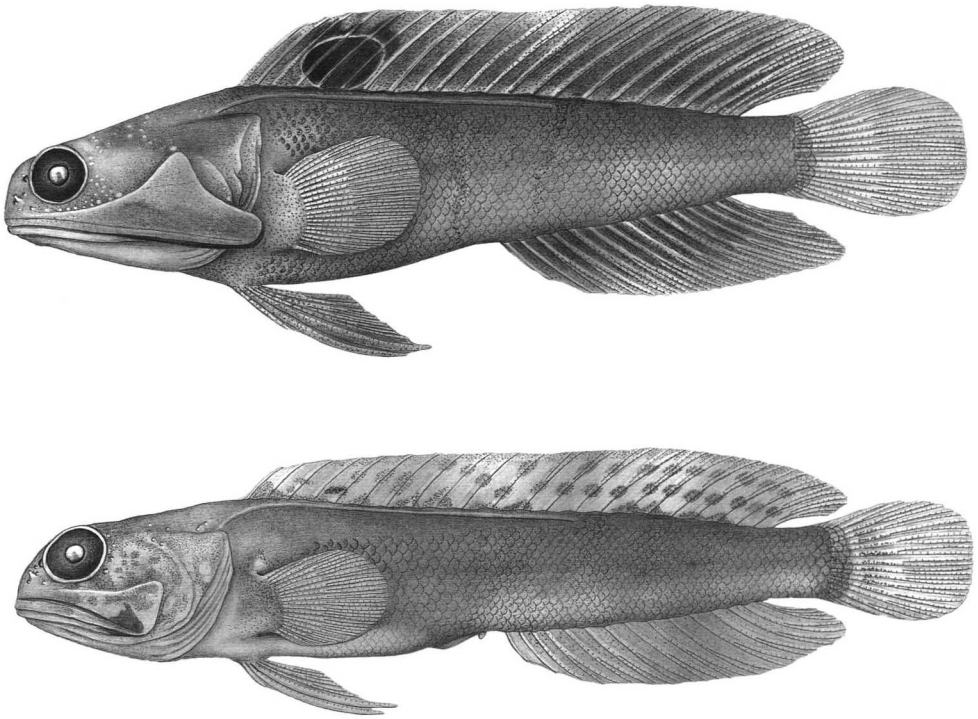

Figure 5. *Opistognathus melachasme* (above), holotype, ANSP 114763, 77 mm SL, male, Yucatan, Arrowsmith Bank; *Opistognathus nothus* (below), holotype, ANSP 127058, 79.3 mm SL, female, North Carolina, off Cape Lookout (both drawings by Jack R. Schroeder).

scaled, except for small area behind pelvic bases, and sides fully scaled except for area above lateral line. Body with 48–51 (includes bilateral counts of holotype only) oblique scale rows in longitudinal series. Lateral-line terminus below verticals from 4th to 5th segmented dorsal-fin rays. Anterior lateral-line pores relatively sparse, arranged in unbranched series and positioned very close to lateral-line tubes, all of which are embedded in skin. Mandibular pore positions all occupied by simple pores, and several preopercular pore positions occupied by pairs of pores (holotype only); infraorbital pore positions mostly consisting of multiple series extending moderately onto cheeks (6a).

Anterior nostril positioned about mid-way between dorsal margin of upper lip and posterior nostril, consisting of short tube without cirrus; height of nostril about 1.0 times maximum diameter of posterior nostril. Dorsal fin moderately high anteriorly, with posterior rays slightly longer; profile relatively uniform without noticeable change in fin height at junction of spinous and segmented rays; dorsal-fin spines slender, slightly curved distally, with flexible tips; all segmented dorsal- and anal-fin rays usually branched distally, occasionally lst ray unbranched. Outermost segmented pelvic-fin ray not tightly bound to adjacent ray, with interradial membrane strongly incised distally; pelvic fin not elongate in adults, tip of depressed fin in front of anal-fin origin. Upper margin of subopercle straight and slightly rounded posterodorsally, not consisting of broad truncated flap; opercle relatively small with dorsalmost spine not noticeably elongate (Fig. 8b); posterior margin of preopercle indistinct, with a slight groove dorsally. No papillae on inner

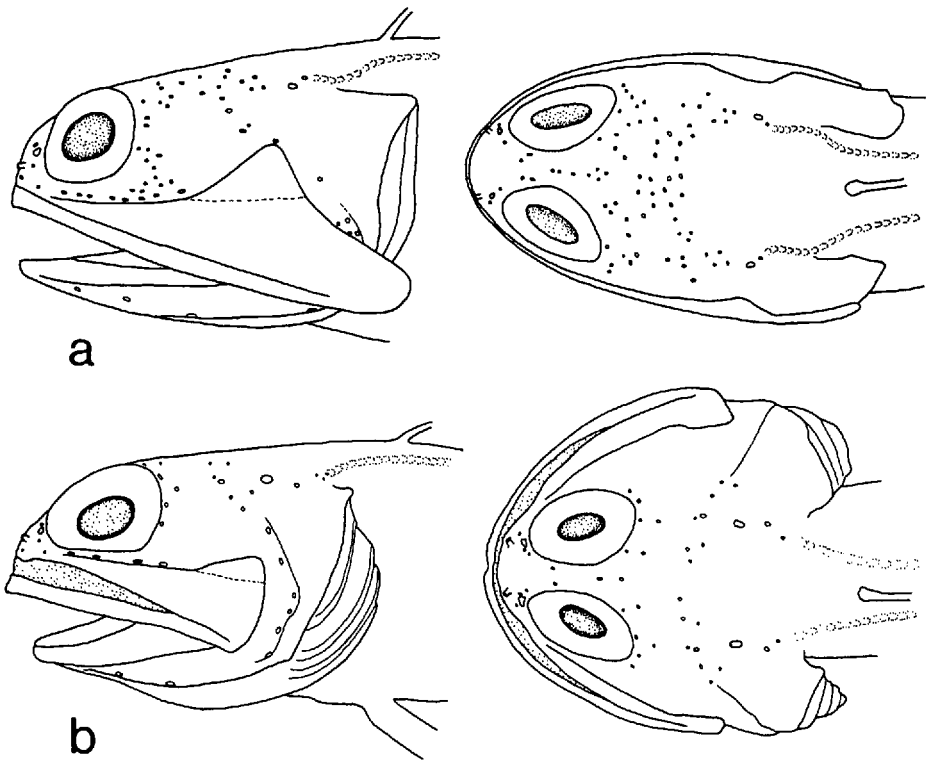

Figure 6. Physiognomy of head and cephalic sensory pores (lateral line pores not shown) of a, *Opistognathus melachasme* and b, *Opistognathus nothus*; data as in Fig. 5.

surface of lips. Fifth cranial nerve passes under A1β section of adductor mandibulae muscle.

Upper jaw very large, extending 0.9 (juvenile) to 2.6 (holotype) eye diameters behind orbit; posterior end of maxilla slightly canted posteroventrally (juvenile) to consisting of an enormous flap (Fig. 6a) extending to below vertical from rear end of opercle (holotype), and with thin, flexible lamina; supramaxilla very large and subterminally positioned. Coronoid (ascending) process of articular tilted slightly backward and club-shaped with dorsal margin smoothly convex (Fig. 7a1). Premaxillary patch of symphyseal teeth, reduced to two rows laterally, and then one row; teeth longer and stouter anteriorly, especially those of the innermost series, several of which are nearly horizontal. Dentary teeth in a patch anteriorly, uniseral laterally; teeth on posterior third of dentary much enlarged and strongly hooked inward. Vomer edentate. Infraorbital bones tubular; third infraorbital robust, with a well developed suborbital shelf (Fig. 7a2).

Coloration.—In preservation the holotype appears as shown in Figure 5, except dark spot in spinous dorsal fin actually centered between spines 4–7; inner maxillary and adjacent membranes with conspicuous black stripe and inner margin of rictus somewhat dark (Fig. 9a); buccal area essentially unpigmented. The paratype differs from the holotype primarily in having paler ground color (scales not peppered with dark melanophores) and fins.

Color notes of fresh holotype made by Carter R. Gilbert and entered in the station log: Red over much of side and top of head. Sides of body lavender with

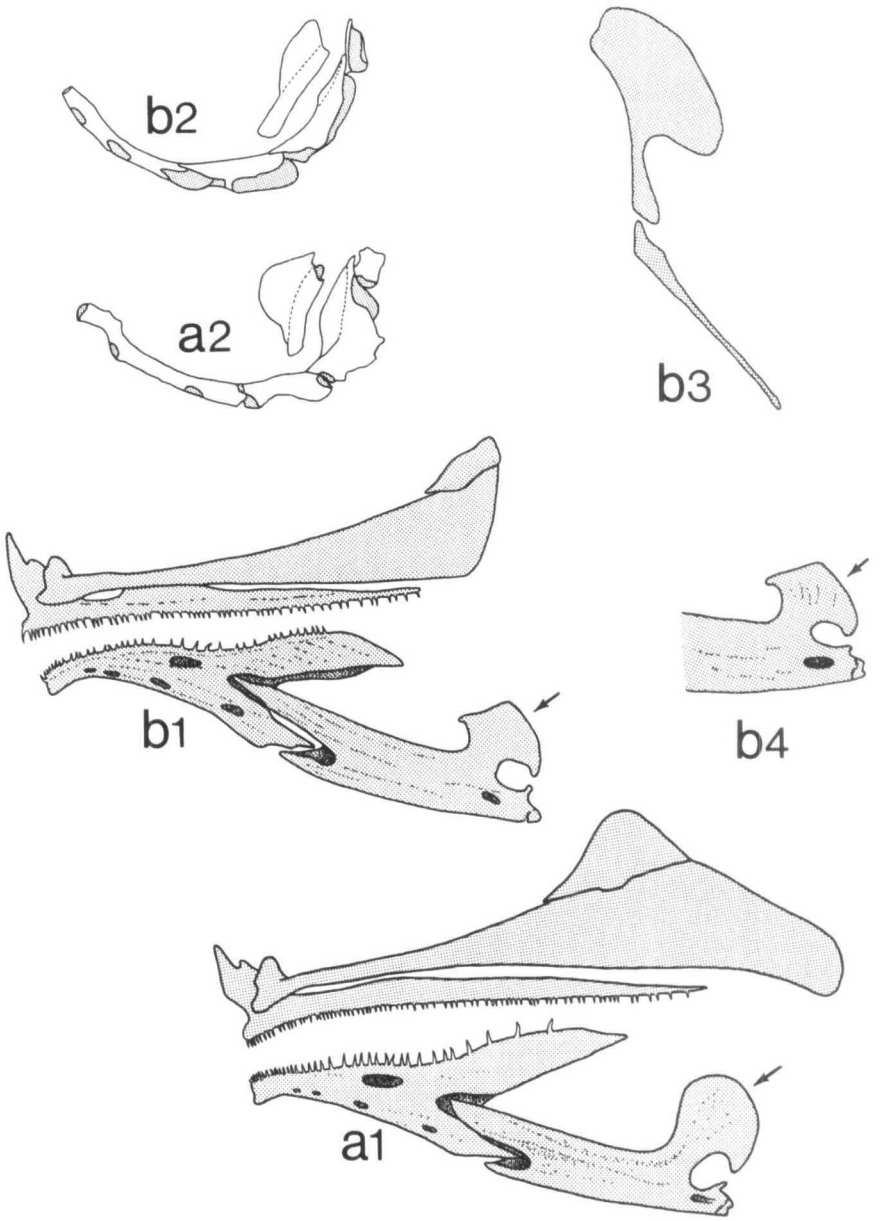

Figure 7. Selected bones (reversed right side views) of (a) *Opistognathus melachasme,* holotype, and (b) *Opistognathus nothus,* ANSP 162313, 65.7 mm SL, except as noted. Upper and lower jaws, small arrow indicates coronoid process of articular (a1, b1); infraorbitals, 3rd infraorbital also in rotated dorsal view (a2, b2); dorsal and ventral postcleithra (b3); coronoid process of holotype (b4).

three red spots, one above pectoral base, second beginning just past end of pectoral fin and third above and behind origin of anal fin. Membranes between first 5 or 6 dorsal spines black. Posteriorly, dorsal fins reddish on distal half, lavender on much of lower half, the red extending to base of fin in some places. Distal edge of dorsal fin black. Anal fin reddish, peppered with black. Caudal fin pinkish. Pelvic fins blackish with slight reddish tinge. Pectoral fins colorless. Outer, pos-

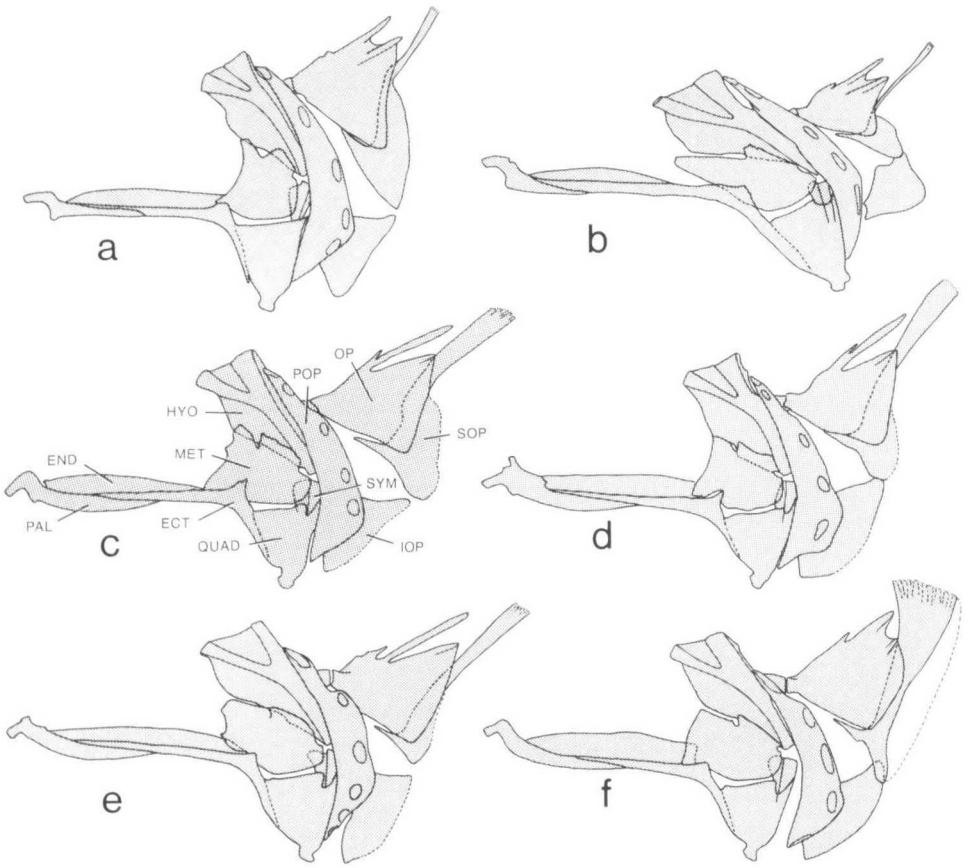

Figure 8. Suspensorium in selected species of *Opistognathus*: a, *O. leprocarus,* ANSP 138563, 45.7 mm SL; b, *O. melachasme,* holotype (reversed right side view); c, *O. macrognathus,* ANSP 138457, 76.5 mm SL; d, *O. robinsi,* ANSP 138566, 70 mm SL; e, *O. whitehurstii,* ANSP 78838, 56.2 mm SL; f, *O. maxillosus,* ANSP 115095, 61.7 mm SL. Abbreviations: ECT—ectopteryoid; END—endopterygoid; HYO—hyomandibular; IOP—interopercle; MET—metapterygoid; OP—opercle; PAL—palatine; POP—preopercle; QUAD—quadrate; SOP—subopercle; SYM—symplectic.

terior end of maxilla pinkish, the edges black. Inner sides of maxilla black. Inside of mouth yellow, except for black corners (underside of maxilla and adjacent membranes). Lower jaws and gular area orange-yellow. Opercular membranes yellowish.

Coloration of juvenile paratype, based on kodachrome slide: Head and body almost uniform lavender, membranes of dorsal fin mostly yellow; spinous dorsal fin with black spot, nearly equal to eye diameter, surrounded by distinct white border. (Ocellus of holotype without distinct pale border, obscured by heavily pigmented surrounding interradial membranes). Underside of maxilla and adjacent membranes heavily pigmented, similar to that of the holotype.

Etymology.—The trival name is derived from the Greek *melas* (black) and *chasme* (a yawn), in reference to the black markings on the underside of the maxilla and adjacent membranes which are largely hidden from view except when the gape is extended. The common name "yellowmouth jawfish" has been linked with *O. melachasme,* although it was originally coined for the holotype of *O. nothus*

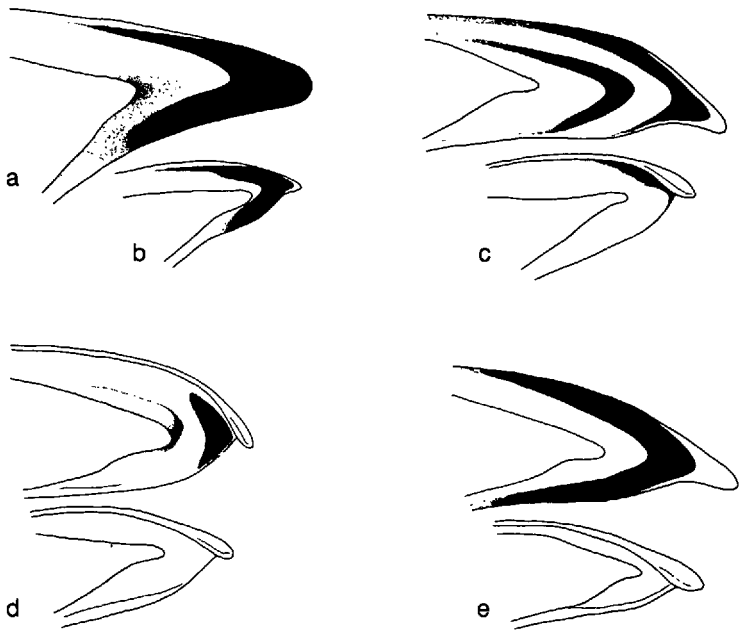

Figure 9. Semidiagrammatic illustrations showing dark pigmentation on inner maxillary and adjacent membranes in selected species of *Opistognathus* (males above, females below): a, *O. melachasme* (holotype); b, *O. nothus* (holotype); c, *O. macrognathus* and *O. brasiliensis*; d, *O. cuvierii*; e, *O robinsi* (some large females resemble *O. macrognathus* females as in c) and *O. signatus.*

Table 7. Morphometric data, expressed as percentages of standard length or head length (*), for *Opistognathus melachasme* and *O. nothus*

	Opistognathus melachasme		*Opistognathus nothus*			
	Holotype	Paratype	Holotype	Paratypes		
Standard length (mm) sex	77.0♂	31.0?	79.3♀	65.7?	61.8?	42♀
Predorsal length	32.8	34.2	31.0	—	34.8	33.3
Preanal length	60.3	60.8	62.9	—	62.1	55.5
Dorsal-fin base	62.5	58.1	61.9	—	63.4	66.7
Anal-fin base	30.3	29.0	30.6	—	29.9	31.0
Pelvic fin length	26.2	25.0	17.4	—	18.2	24.0
Caudal fin length	19.9	25.8	18.2	20.3	—	23.5
Depth anal-fin origin	17.8	17.4	14.3	—	14.7	17.3
Caudal peduncle depth	9.6	10.0	6.9	7.8	7.6	9.5
Length 5th dorsal spine	14.9	14.5	8.6	—	—	11.9
Length 5th dorsal ray	17.7	15.5	12.1	—	—	14.8
Head length	34.9	34.8	29.0	—	34.1	34.5
Postorbital head length	21.7	21.3	15.7	—	—	19.5
Orbit diameter	9.2	11.0	9.1	10.5	12.8	11.9
Upper jaw length	34.7	21.3	22.2	24.8	25.3	25.0
*Postorbital head length	62.1	61.1	54.1	—	—	56.6
*Orbit diameter	26.4	31.5	31.3	—	37.4	34.5
*Upper jaw length	99.3	72.2	76.5	—	74.2	72.4
*Postorbital jaw length	69.9	29.2	34.8	—	28.7	31.7

(Robins et al., 1980:50) the species to which the name is herein applied. Megamouth jawfish is suggested as a substitute common name for *O. melachasme.*

Remarks.—Anderson and Smith-Vaniz (1976) compared the male holotype of *Opistognathus melachasme* with a gravid female from off North Carolina (herein described as the new species *O. nothus*), which they considered to be conspecific, and attributed obvious differences to sexual dimorphism. As discussed under "Remarks" in the following species account, these two species are believed to be sister taxa.

Distribution (Fig. 4).—Known only from Arrowsmith Bank off Yucatan where trawled on rough bottom in depths between 146–265 and 155–205 m, respectively.

Material Examined.—2 specimens, 31–77 mm SL. Holotype: ANSP 114763 (77) Paratype: UF 228548 (31).

Opistognathus nothus new species
Figures 5, 6b, 7b1–4, 9b; Tables 2–5, 7

Opistognathus melachasme (*non* Smith-Vaniz). Anderson and Smith-Vaniz, 1976:202, fig. 1 (misident.in part; description; "sexual dimorphism"; North Carolina); Robins et al., 1980:50 (common name "yellowmouth jawfish").

Diagnosis.—A species of *Opistognathus* distinguished from all others by the following combination of characters: anterior nostril a short tube without cirrus on posterior rim; posterior end of maxilla rigid, not produced as a thin flexible lamina; coronoid process of articular hatchet-shaped with dorsal margin straight; vomer edentate; inner lining of maxilla and adjacent membranes with conspicuous black stripe; spinous dorsal fin without an ocellus; segmented dorsal- and anal-fin rays 14 and 13, respectively; caudal vertebrae 18.

Description.—Dorsal fin X, 14. Anal fin II, 13. Pectoral-fin rays 20 or 21. Caudal fin: procurrent rays 3+2, segmented rays 8+8, middle 12–14 branched; hypural 5 present. Vertebrae: 10 + 18, last pleural rib on vertebra 10, epineurals 11–13. Supraneural bones absent. Gill rakers 8–9 + 18–23 = 26–32.

Scales absent from head, nape, pectoral-fin base, breast, anterior third of belly, and above lateral line; sides fully scaled to a vertical below 4th dorsal-fin spine. Body with 44–50 oblique scale rows in longitudinal series. Lateral-line terminus below verticals from 2nd to 4th segmented dorsal-fin rays. Anterior lateral-line pores relatively sparse, arranged in unbranched series and positioned very close to lateral-line tubes, all of which are embedded in skin. Mandibulo-preopercular and infraorbital pore positions all occupied by simple pores; infraorbital pore positions all consisting of simple pores which extend only slightly onto cheeks (Fig. 6b).

Anterior nostril positioned about mid-way between dorsal margin of upper lip and posterior nostril, consisting of short tube without cirrus; height of anterior nostril about 1.0 times maximum diameter of posterior nostril. Dorsal fin moderately low anteriorly, with posterior rays slightly longer; profile relatively uniform without noticeable change in fin height at junction of spinous and segmented rays; dorsal-fin spines slender and relatively straight with flexible tips; all segmented dorsal- and anal-fin rays usually branched distally. Outermost segmented pelvic-fin ray not tightly bound to adjacent ray, interradial membrane strongly incised distally; pelvic fin not elongate in adults, tip of depressed fin in front of anal-fin origin. Upper margin of subopercle straight, slightly rounded posterodor-

sally, not consisting of broad truncated flap; opercle relatively small with dorsalmost spine not noticeably elongate; posterior margin of preopercle indistinct, with a slight groove dorsally. No papillae on inner surface of lips. Fifth cranial nerve passes under A1β section of adductor mandibulae muscle.

Upper jaw moderate, extending 0.8 to 1.1 eye diameters behind orbit; posterior end of maxilla rigid and truncate, without a thin flexible lamina; supramaxilla moderate and terminally positioned. Coronoid (ascending) process of articular hatchet-shaped with dorsal margin straight (Figs. 7b1, 7b4). Premaxillary patch of symphyseal teeth, reduced to one row laterally; teeth longer and stouter anteriorly, some of the posteriormost teeth in anterior series canted backwards and nearly horizontal. Dentary teeth in a patch anteriorly, those in outer row largest and many in inner series hooked backward, some nearly horizontal; dentary teeth uniserial laterally some slightly enlarged and hooked inward. Vomer edentate. Infraorbital bones mostly trough-like; third infraorbital with a moderate suborbital shelf (Fig. 7b2). Postcleithra closely approximated to each other (Fig. 7b3); dorsal postcleithrum cresent-shaped with a narrow ventral arm; ventral postcleithrum club-shaped, broadest dorsally and with a narrow, blunt ventral end.

Coloration.—In preservaion as shown in Figure 5; inner maxillary and adjacent membranes with a conspicuous black stripe (Fig. 9b) which is also partially visible laterally; ground color dark tan; head, especially around some of the cephalic pores, with dark brown spots; fins rather uniformly pigmented except dorsal fin which has several rows of brown spots mostly centered on fin spines and rays; buccal area unpigmented. Color pattern of Gulf of Mexico paratypes agrees well with the holotype except spinous dorsal fin has dusky oblong blotch between spines 3–6.

The following notes on coloration of the holotype, made 12 days after initial preservation, are slightly modified from Anderson and Smith-Vaniz (1976): Head and body brown dorsally and dorsolaterally, pale ventrally. Lips of lower jaw yellow near corners of mouth along medial surface of premaxilla. Areas behind maxilla and between maxilla and premaxilla with considerable yellow. Interior of mouth on either side of premaxilla yellow. Dorsal and anal fins each with a yellow stripe near distal border. Each dorsal spine and segmented ray with one to three elongated areas of brown pigment that spill over onto adjacent interradial membranes; however, most pigment associated with first two spines confined to membranes. A larger, darker (almost black) rectangular area of pigment (with longer axis horizontal) on membrane between fourth and fifth dorsal spines and on fifth spine. Pectoral and pelvic fins pale. Caudal fin with two yellow stripes, one on upper border and one on lower border; these stripes apparently connected in life near distal margin of fin.

Etymology.—The Latin trival name *nothus* (false or counterfeit), here treated as a noun in apposition, alludes to the erroneous initial belief that the female holotype was the sexually dimorphic counterpart of *Opistognathus melachasme* males. The recommended common name, yellowmouth jawfish, (Robins et al. 1980) is still appropriate for this species although originally associated with a different scientific name.

Remarks.—Anderson and Smith-Vaniz (1976) discussed the presumed remarkable sexual dimorphism of *Opistognathus melachasme* based on the male holotype and a subsequently collected gravid female. At that time the species was known from four specimens: the holotype and a small juvenile from off Yucatan, another adult (sex undetermined) in a very poor state of preservation from Cuba, and the female

from off North Carolina. Obvious differences between the holotype and North Carolina female, including morphometrics (Table 7) and color pattern, were attributed to sexual dimorphism, and differences in extent of scalation and cephalic pore development, although pronounced, were considered to be within the range of possible infraspecific variation. Following publication of their paper, two additional specimens were collected from the Gulf of Mexico, both clearly conspecific with the North Carolina specimen; one is a small, gravid female, the other, damaged by the sample dredge, could not be sexed. Because no other known species of jawfish exhibits such an extreme degree of sexual dimorphism and both sexes had not been taken in the same collection, the possibility that two closely related species were actually represented was reconsidered. One of the Gulf of Mexico specimens was cleared and stained, revealing that its lower jaw has an articular with a distinctly hatchet-shaped coronoid process (Figs. 7b1). To compare this and other bones in both the holotype of *Opistognathus melachasme* and in the North Carolina female, the facing bones on the right side of these specimens were removed and cleared and stained. The coronoid process of the North Carolina specimen (Fig. 7b4) was found to be virtually identical to that of the Gulf of Mexico specimen and in contrast to the club-shaped process (Fig. 7a1) of both Yucatan specimens (condition in juvenile determined by partial dissection). Based on examination of extensive cleared and stained material, in opistognathids the coronoid process is infraspecifically generally consistent, including species with sexually dimorphic upper jaws, and its shape exhibits no obvious relationship to upper jaw elongation. The infraorbital bones of the holotype of *O. melachasme* (Fig. 7a2) also differ noticeably from those of *O. nothus* (Fig. 7b2); infraorbitals examined in two specimens of *O nothus.* The three specimens of *O. nothus* with intact caudal fins all agree in having fewer procurrent caudal rays 3+2, versus 3+4 in the the two types of *O. melachasme.* Considering the noticeably dissimilar coronoid processes and other differences mentioned above, it seems obvious now that the Yucatan and North American specimens actually represent different species. The Cuban specimen also has a hatchet-shaped coronoid process, confirming its identity as *Opistognathus nothus,* although it was originally designated as a paratype of *O. melachasme.*

Characters shared by both species that suggest they are sister taxa are as follows: 1) Coronoid process of articular with a posteroventral lip that forms part of an almost completely circular articulating surface that provides a very tight connection with the ventral end of the quadrate (Figs. 7a1, 7b1, 7b4) [The quadrate is strongly tilted backward (Fig. 8b), as opposed to a more vertical alignment in other western Atlantic jawfishes; this arrangement and the tighter articular-quadrate connection are probably correlated functional adaptations associated with greater rotation of the lower jaw.]; 2) opercle relatively small compared to other Atlantic congeners (Fig. 8b); 3) unique combination of meristic characters (among Atlantic species only *O. gilberti* has the same number of vertebrae, anal- spine/ray and dorsal-fin ray counts, except that it typically has XI instead of X dorsal spines); 4) only one other Atlantic *Opistognathus* lacks vomerine teeth (an undescribed dwarf species which lacks a lateral line in addition to other unique characters); and 5) black stripe on inner lining of the maxilla and adjacent membranes very similar in both species (Figs. 9a–b), with the inside of the mouth otherwise mostly yellow.

Distribution (Fig. 4).—Known from off North Carolina, Gulf of Mexico, and Cuba in depths of 92–100 m.

Material Examined.—4 specimens, 42–79 mm SL. Holotype: ANSP 127058 (79.3), North Carolina,

59 km off Cape Lookout, 34°08.5'N, 76°10.3'W, dipnetted at surface (presumably disgorged by one of several hook-and-line caught bottom fish) over a depth of 100–102 m, 16 May 1973, W. D. Anderson, Jr. Paratypes: GULF OF MEXICO: AMNH 82388 (1, 42) and ANSP 162313 (1, 65.7, C&S), off Alabama, 29°33'N, 87°23.7'W, dredged in 92 m, 19 Oct 1975, R. L. Shipp et al. CUBA: USNM 37462 (1, 61.8), probably Havana vicinity, received from F. Poey, ca. 1885.

Opistognathus macrognathus species group

The combination of a simple cirrus on anterior nostril, similar jaw bones and dentition, including sexually dimorphic maxillae, dichromatic jaw markings, conspicuous buccal pigmentation, and dorsalmost spine of opercle noticeably elongate, Figs. 8c–d (elongate spine also present in *O whitehurstii,* Fig. 8e) is restricted to some New World species of *Opistognathus.* These include five Atlantic species (*macrognathus, brasiliensis, cuverii, robinsi,* and *signatus*) and three eastern Pacific species (*scops, punctatus,* and one undescribed species). Based on color pattern, the latter two species do not appear to be closely related to the five western species which, together with *O. scops* (see "Comparisons" under account of *O. cuvierii*), comprise the *Opistognathus macrognathus* species group. These species all share the following character states, none unique to them: dark spot or ocellus in spinous dorsal fin; vomer with 1–4 large teeth; coronoid process of articular club-shaped; infraorbital bones tubelike, the 3rd infraorbital with a moderate suborbital shelf; postcleithra consisting of two well-separated bones, dorsal postcleithrum thin and disk-shaped, and ventral postcleithrum rod-shaped with pointed ends; typically XI dorsal-fin spines; III anal-fin spines; hypural 5 absent; and all lateral-line tubes embedded in skin, none on dorsal surface of anterior scales.

Western Atlantic members of the *Opistognathus macrognathus* species group are compared in Table 8, and the following key is given as an identification aid to all western Atlantic species of *Opistognathus.* Those species not treated in this paper will be the subject of a subsequent paper by the author.

Key to Western Atlantic Species of *Opistognathus*

1a. Segmented anal-fin rays 9; total dorsal-fin elements 20 or 21; lateral line absent; segmented caudal-fin rays 14, middle 10 branched distally ..... *O.* species 1
1b. Segmented anal-fin rays 11–17; total dorsal-fin elements 22–28; lateral line present; segmented caudal-fin rays 16 (exceptionally 15), middle 11–13 branched distally 2
2a. Anterior nostril a short tube without a cirrus 3
2b. Anterior nostril with simple cirrus on posterior rim 10
3a. Opercle with prominent dark blotch; dorsal-fin spines straight distally, with rigid sharp tips; cheeks completely scaled ..... *O. leprocarus*
3b. Opercle uniformly pigmented; dorsal-fin spines curved distally, with slender flexible tips; cheeks naked (except frequently scaled in *O. megalepis*) 4
4a. Segmented anal- and dorsal-fin rays 11 and 11 or 12, respectively; body with 26–42 oblique scale rows ..... *O. megalepis*
4b. Segmented anal- and dorsal-fin rays 12 or more, respectively; body with 44–87 oblique scale rows 5
5a. Dorsal-fin spines 10; vomerine teeth absent; inner lining of upper jaw and adjacent membranes mostly black; total gill rakers on first arch 26–32 6
5b. Dorsal-fin spines typically 11; vomerine teeth typically present; inner lining of upper jaw and adjacent membranes pale; total gill rakers on first arch 34–62 7
6a. Posterior end of maxilla produced as a thin flexible lamina; coronoid process of articular club-shaped with dorsal margin smoothly convex (Fig. 7a1) ..... *O. melachasme*
6b. Posterior end of maxilla rigid, not produced as a thin flexible lamina; coronoid process of articular hatchet-shaped with dorsal margin straight (Figs. 7b1, 7b4) ..... *O. nothus* n. sp.
7a. Outermost segmented pelvic-fin ray tightly bound to adjacent ray and interradial membrane not incised distally; dorsal fin with narrow, dark border (blue in life); segmented anal-fin rays 14–17; caudal fin 30–41 % SL 8

Table 8. Comparison of selected western Atlantic species of *Opistognathus*.

	macrognathus	*brasiliensis*	*cuvierii*	*robinsi*	*signatus*
Spinous dorsal fin spot encircled by white ring	no	yes (very narrow)	yes (wide)	yes (wide)	like *robinsi*
Dorsal and anal fins with numerous white spots	no	no	yes	yes	like *robinsi*
Dorsal fin dusky bands	5 or 6 that extend onto body dorsally	like *macrognathus*	absent	absent	like *robinsi*
Adults with bands on mid-side	yes	no	no	no	like *robinsi*
Pectoral-fin pigmentation	numerous black speckles proximally	no black speckles; fin uniformly pigmented	no black speckles; pale speckles or spots present ?	no black speckles; pale speckles or spots often present	like *robinsi*
Inner maxillary dark stripes in males (♂) and females (♀)	♂ two brown stripes; ♀ one brown stripe (Fig. 9c)	like *macrognathus* (Fig. 9c)	♂ two brown stripes, innermost stripe poorly developed; ♀ stripe absent (Fig. 9d)	♂ one black stripe; ♀ stripe absent or in large females light brown stripe sometimes present (Fig. 9e)	like *robinsi*
Buccal pigmentation	dark pigment widely surrounds esophageal opening except for a pale oblong area below each upper pharyngeal (Fig. 13a)	dark pigment widely surrounds esophageal opening anteriorly and laterally except for pale area posteriorly that continues between upper pharyngeals (Fig. 13b)	dark blotch on either side of esophageal opening widely separated by pale median area that continues between upper pharyngeals (Fig. 13c)	dark pigment widely surrounds esophageal opening, including medial area between upper pharyngeals (Fig. 13d)	like *robinsi*
Prominent dark spot on a few scattered body scales	no	no	no	no	yes
Oblique body scale rows in longitudinal series	76-95, $\bar{x}$ 84.5	59-75, $\bar{x}$ 65.7	60-72, $\bar{x}$ 67.0	73-88, $\bar{x}$ 79.5	57-70, $\bar{x}$ 63.5
Caudal vertebrae	18-20, typically 19	18	19	19-21, typically 20	19 or 20, usually 20
Total procurrent caudal-fin rays	7-9, modally 8	7-9	5 or 6	6-8, rarely 8	6 or 7

7b. Outermost segmented pelvic-fin ray not tightly bound to adjacent ray and interradial membrane incised distally; dorsal fin without narrow, dark border; segmented anal-fin rays 12–14 (rarely 14); caudal fin 19–30 % SL 9

8a. Head with narrow, dark stripe that extends from posteroventral margin of eye and crosses head about one-half eye diameter behind margin of orbit; dorsum of head conspicuously bicolored, abruptly pale anterior to postorbital stripe; gular region crossed by a pale band approximately between 2nd and 3rd mandibular pore positions (Tobago and Brazil) . . . . . *O.* species 2

8b. Head without narrow, dark stripe that extends from posteroventral margin of eye and crosses nape; dorsum of head not abruptly and conspicuously bicolored; gular region not crossed by a pale band (broadly distributed throughout the Caribbean but unknown from Tobago) . . . . . *O. aurifrons*

9a. Posterior end of maxilla nearly truncate and noticeably expanded; black spot present in spinous dorsal fin of adult males; segmented anal-fin rays 12–14 (typically 13); caudal vertebrae 18 or 19 . . . . . *O. gilberti*

9b. Posterior end of maxilla ovate and only slightly expanded; no black spot in spinous dorsal fin of adult males; segmented anal-fin rays 12 or 13 (rarely 13); caudal vertebrae 16 . . . . . *O. lonchurus*

10a. Adults with posterior end of maxilla ending as thin, flexible lamina (slightly elongate in mature females and very elongate in males); dorsal-fin spines thin, flexible, usually curved distally, and tips without pale, slightly swollen fleshy tabs; segmented dorsal-fin rays 15–18, rarely 15; cephalic sensory pores less numerous (Figs. 12, 24), most of posterior half of median predorsal region of head without pores 10

10b. Adults with posterior end of the maxilla rigid, not ending as thin, flexible lamina; dorsal-fin spines stiff, straight, the skin-covered tips usually with pale, slightly swollen fleshy tabs; segmented dorsal-fin rays 13–16, rarely 16; cephalic sensory pores more numerous (Figs. 31, 36), median predorsal region of head completely pored or almost so 15

11a. Dorsal fin with 5 or 6 dusky bands, some clearly evident well above base of fin; total gill rakers on first arch usually more numerous (Figs. 17–18), 31–43 in specimens >50 mm SL 12

11b. Dorsal fin without 5 or 6 dusky bands or bands only evident at base of fin; total gill rakers on first arch usually less numerous, 28–35 in specimens >50 mm SL 13

12a. Pectoral fin with numerous black speckles proximally; body with 5 or 6 dark bands on mid-sides; dark pigment widely surrounds esophageal opening except for pale, oblong area below each upper pharyngeal tooth patch (Fig. 13a); caudal vertebrae typically 19 (Florida and Bahamas to northern South America) . . . . . *O. macrognathus*

12b. Pectoral fin uniformly pigmented; body without 5 or 6 dark bands on mid-sides; dark pigment widely surrounds esophageal opening except for pale area posteriorly that continues between upper pharyngeal tooth patches (Fig. 13b); caudal vertebrae 18 (southern Brazil) . . . . . *O. brasiliensis* n. sp.

13a. Inner lining of upper jaw and adjacent membranes of adult males with two brown stripes, innermost stripe poorly developed (Fig. 9d); dark blotch on either side of esophageal opening widely separated by pale median area that continues between upper pharyngeal tooth patches (Fig. 13c); segmented anal-fin rays 16; caudal vertebrae 19 (southern Brazil) . . . . . *O. cuvierii*

13b. Inner lining of upper jaw and adjacent membranes of adult males with one black stripe (Fig. 9e); dark pigment widely surrounds esophageal opening, including medial area between upper pharyngeal tooth patches (Fig. 13d); segmented anal-fin rays 16–18, usually 17; caudal vertebrae 19–21, usually 20 14

14a. Background color pattern of body typically mottled with shades of brown but without heavily pigmented body scales giving the appearance of isolated dark spots; body with 73–88 oblique scale rows in longitudinal series; orbit diameter usually smaller (Fig. 28) (South Carolina, Florida, Bahamas, and Gulf of Mexico) . . . . . *O. robinsi* n. sp.

14b. A few scattered body scales heavily pigmented, each appearing as an isolated, prominent, dark spot; body with 57–70 oblique scale rows in longitudinal series; orbit diameter usually larger (Fig. 28) (Nicaragua, Panama, and northern South America) . . . . . *O. signathus* n. sp.

15a. Fleshy cirrus on anterior nostril moderately slender; upper margin of subopercle not a broad, fan-like, truncated flap (Figs. 8e, 31); premaxilla with one row of teeth anteriorly; supramaxilla present; area surrounding esophageal opening immaculate; body with 42–54 oblique scale rows; mature males with posteriormost 2–4 premaxillary teeth usually stouter and more strongly hooked than adjacent teeth (Figs. 33a–b); caudal vertebrae 16–18, typically 17 . . . . . *O. whitehurstii*

15b. Fleshy cirrus on anterior nostril broadly rounded to palmate; upper margin of subopercle a broad, fan-like, truncated flap (Figs. 8f, 36); premaxilla with two or more rows of teeth

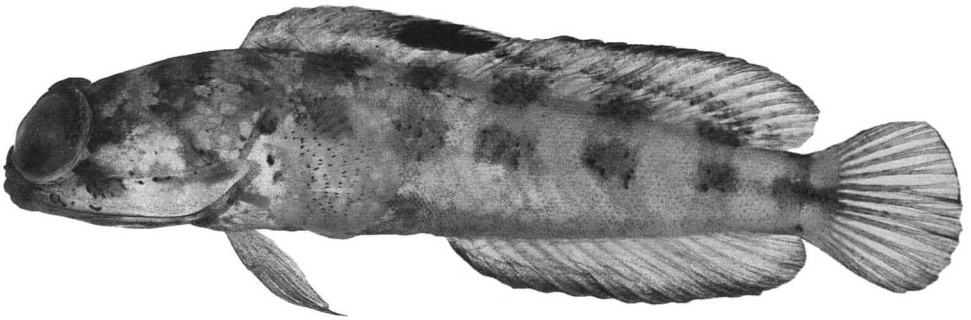

Figure 10. *Opistognathus macrognathus,* ANSP 141704, 86.2 mm SL, male, Puerto Rico, Laurel Reef.

anteriorly; supramaxilla absent; dark pigment completely surrounds esophageal opening (Fig. 37d); body with 69–85 oblique scale rows; mature males with posteriormost 2–4 premaxillary teeth undifferentiated from adjacent teeth; caudal vertebrae 17–19, typically 18 . . . . . *O. maxillosus*

Opistognathus macrognathus Poey, 1860
Figures 8c, 9c, 10–13a, 14–15, 17; Tables 2–5, 8

Opisthognathus macrognathus Poey, 1860 [July]:284, pl. 18, fig. 7 (orig. descr.: Cuba; holotype presumably lost); Howell-Rivero, 1936:66 (Cuban record); Duarte-Bello, 1959:106 (listed); Cervigón, 1966:638, figs. 274–275 (description); Randall, 1967:789 (food habits).

Opisthognathus macrognathum. Jordan and Evermann, 1898:2281 (description; *Opisthognathus megastoma* and *O. scaphiurus* synonymized); Jordan, Evermann and Clark, 1930:452 (listed).

Opistognathus macrognathus. Starck, 1968:28 (Alligator Reef, Florida); Randall, 1968:168, fig. 191 (description); Robins et al., 1980:50 (common name "banded jawfish"); Gilmore et al., 1981:21 (listed from offshore reefs adjacent to Indian River Lagoon, Florida); Acero P., et al., 1984:76, fig. 9 (description; Rosario and San Bernardo islands); Robins and Ray, 1986:216, color pl. 43 (brief descr.); Hess, 1993:812 (male mouth brooding; reproductive biology); Cervigón, 1994:18, text fig.4a–b, color pl. 1, fig. 4 (description); Humann, 1994:286, unnumbered color pl. (brief diagnosis).

Opisthognathus macrops Poey, 1860 [July]:287 (orig. descr.: Cuba; holotype MCZ 12514); Duarte-Bello, 1959:106 (listed).

Gnathypops macrops. Jordan and Evermann, 1898:2284 (compiled, after Poey).

Opisthognathus megastoma Günther, 1860 [October]:255 (orig. descr.: Gulf of Mexico, Haslar Coll.; syntypes BMNH 1855.9.19.394); Jordan and Evermann, 1898:2281 (synonymized with *O. macrognathus*).

Opisthognathus scaphiurus Goode and Bean, 1882:417 (orig. descr.: Garden Key, Florida; holotype USNM 5936); Jordan and Gilbert, 1882:943 (redescription); Jordan and Evermann, 1898:2281 (synonymized with *O. macrognathus*).

Opisthognathus fasciatum Longley *in* Longley and Hildebrand, 1940:259, fig. 18 (orig. descr.: Tortugas, Florida; holotype USNM 108873).

Opistognathus fasciatus. Böhlke and Chaplin, 1968:486, unnumbered fig. (description; habits); Bailey et al., 1970:47 (common name "banded jawfish"); Robins et al., 1980:87 (synonym of *O. macrognathus*).

Diagnosis.—A species of *Opistognathus* distinguished from all others by the following combination of characters: anterior nostril a short tube with simple cirrus on posterior rim; posterior end of maxilla of adults males produced as a thin flexible lamina that usually extends beyond posterior margin of opercle; dorsal fin with 5 or 6 dusky bands that extend onto dorsum; spinous dorsal fin with a black spot not encircled by a white ring; mid-sides with 5 or 6 dark blotches, sometimes conjoined with those on dorsum; adult males with inner lining of maxilla and adjacent membranes with two dark stripes, one stripe in females;

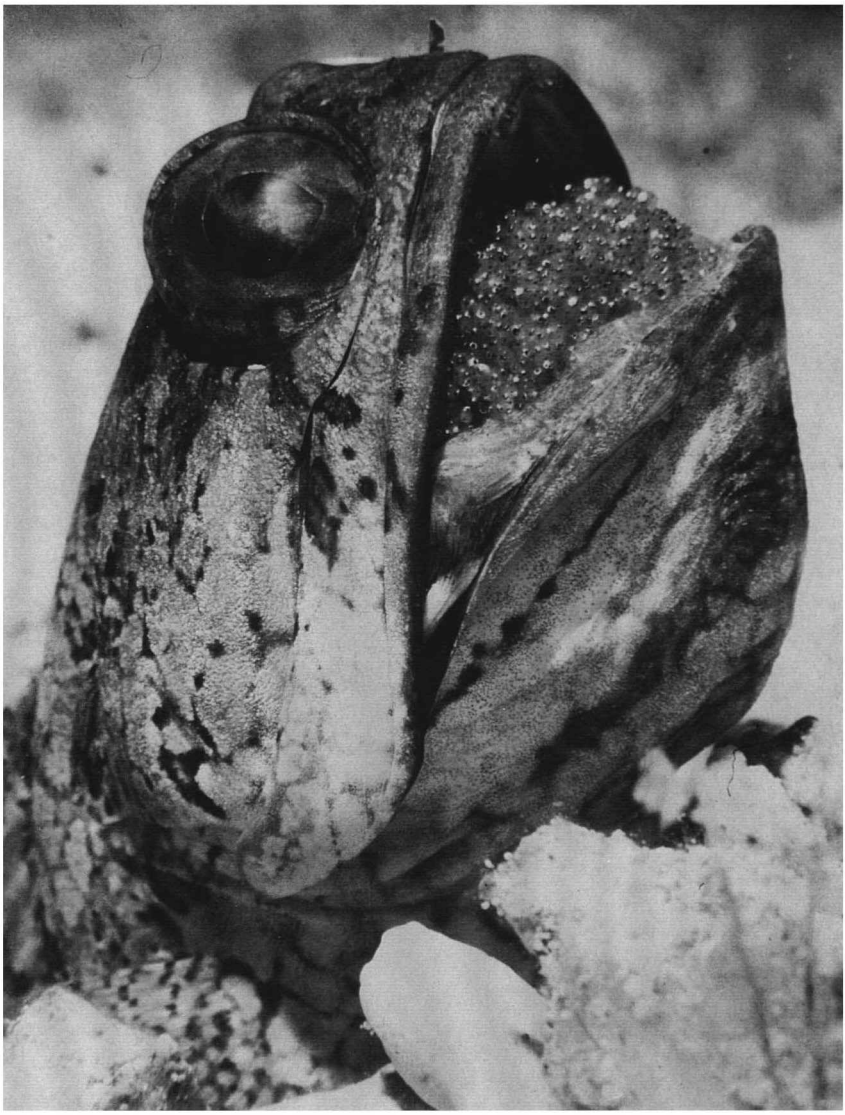

Figure 11. *Opistognathus macrognathus*, male brooding eggs, Grand Turk, Turks and Caicos Islands (photograph by Fred McConnaughey).

pectoral fin with numerous black speckles proximally; buccal pigmentation consisting of a dark area widely surrounding esophageal opening except for pale oblong area below each upper pharyngeal (Fig. 13a); caudal vertebrae typically 19.

Description.—Dorsal fin X–XII (typically XI), 15–17 = 26–29 total. Anal fin II or III (rarely II), 15 or 16. Pectoral-fin rays 19–22. Caudal fin: procurrent rays 4–5+3–4, segmented rays 8 + 8, middle 12 or 13 branched, total elements 23–25; hypural 5 absent. Vertebrae: 10 + 18–20; last pleural rib on vertebra 10, epineurals 12–17. Supraneural bones 2. Gill rakers (number increasing with increase in SL, see Fig. 17) 9–15 + 21–28 = 31–43.

Scales absent on head, nape, pectoral-fin base, and breast; belly completely

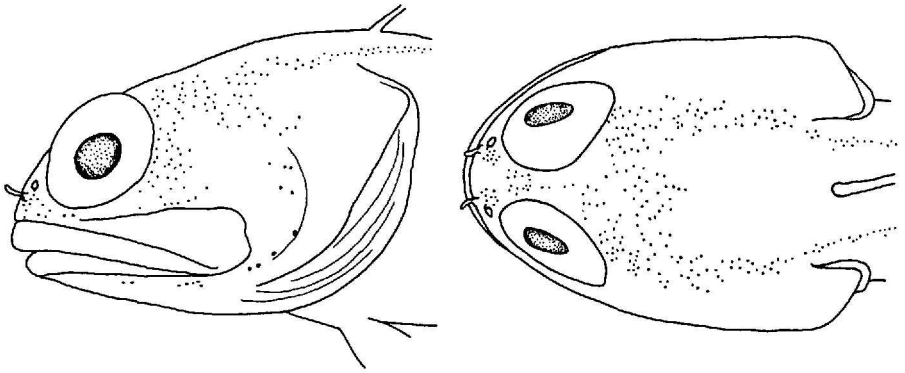

Figure 12. Physiognomy of head and cephalic sensory pores in *Opistognathus macrognathus,* UF 35663, 76.8 mm SL, female, Florida, Palm Beach Inlet.

scaled, except for small area behind pelvic bases, and sides fully scaled except for short area anteriorly above lateral line. Body with 72–95 oblique scale rows in longitudinal series. Lateral-line terminus below verticals between 2nd to 7th segmented dorsal-fin rays. Anterior lateral-line pores relatively sparse, arranged

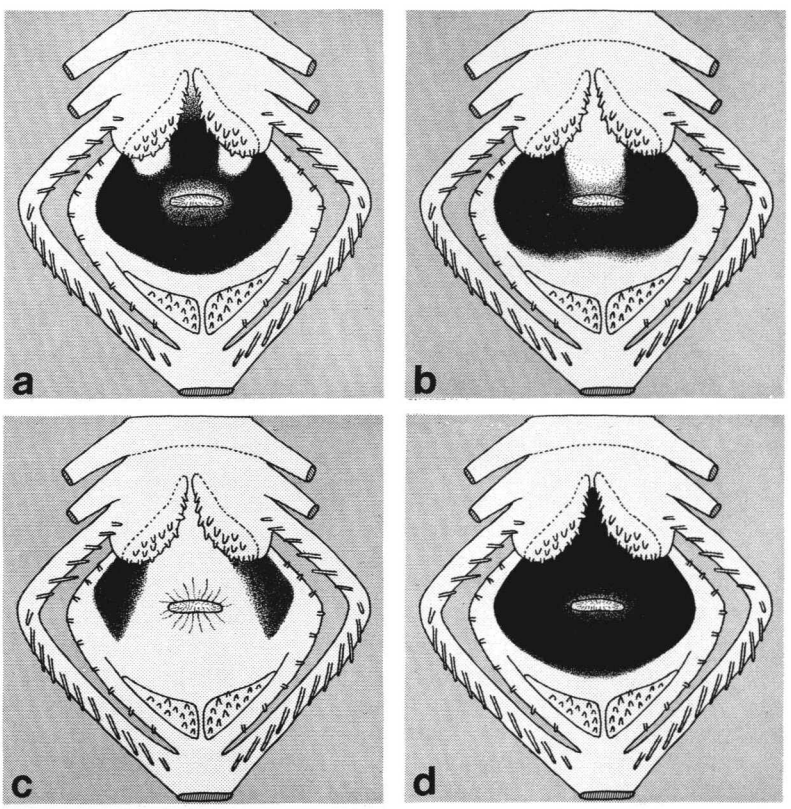

Figure 13. Semidiagrammatic drawings showing buccal pigmentation in selected western Atlantic species of *Opistognathus*: a, *O. macrognathus*; b, *O. brasiliensis*; c, *O. cuvierii*; d, *O. robinsi* and *O. signatus.*

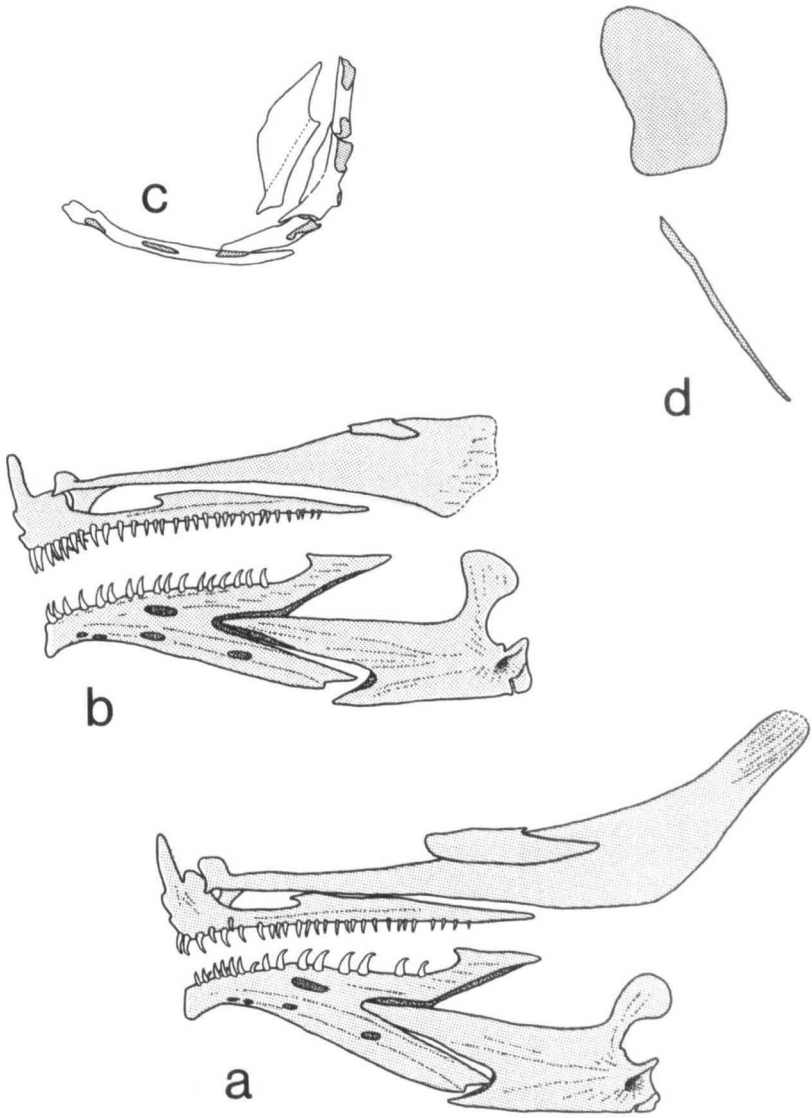

Figure 14. Selected bones in lateral views of *Opistognathus macrognathus*: a, upper and lower jaws of male, ANSP 138457, 85.5 mm SL; b, upper and lower jaws of female, ANSP 138457, 76.5 mm SL; c, infraorbital bones (3rd infraorbital also in rotated dorsal view); d, dorsal and ventral postcleithra.

in unbranched series and positioned very close to lateral-line tubes, all of which are embedded in skin. Mandibular pore positions mostly consisting of multiple pore series, except first two mandibular pore positions occupied by simple pores; preopercular pore positions mostly occupied by simple pores, a few sometimes bipored in large specimens. Infraorbital pore positions consisting of multiple series, which extend moderately onto cheeks. Pores on nape moderately developed, unpored median predorsal area approximately one eye diameter in length (Fig. 12).

Anterior nostril positioned about mid-way between dorsal margin of upper lip and anterior margin of orbit, consisting of short tube with a simple, flattened,

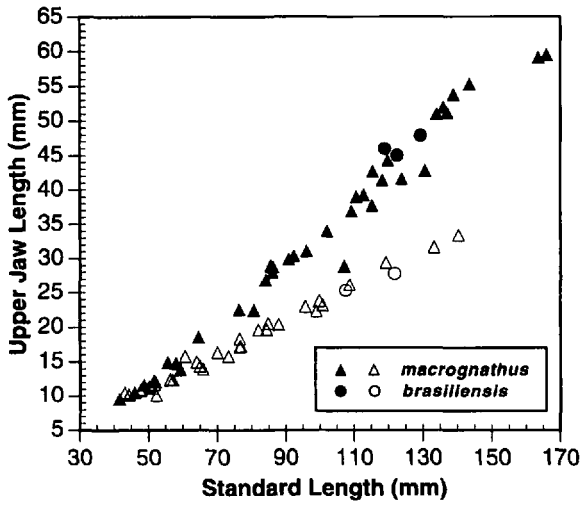

Figure 15. Relationship between upper jaw length versus standard length in *Opistognathus macrognathus* and *O. braziliensis*. Solid symbols = males; open symbols = females.

posterior cirrus which usually reaches anterior margin of orbit when depressed; height of cirrus 1.0–1.5 times maximum diameter of posterior nostril. Dorsal fin moderately high anteriorly, with posterior rays slightly longer; profile relatively uniform without noticeable change in fin height at junction of spinous and segmented rays; dorsal-fin spines slender, usually curved distally, with flexible tips; all segmented dorsal- and anal-fin rays usually branched distally, occasionally lst ray unbranched. Outermost segmented pelvic-fin ray not tightly bound to adjacent ray, interradial membrane strongly incised distally; pelvic fin not elongate in adults, tip of depressed fin in front of anal-fin origin. Upper margin of subopercle

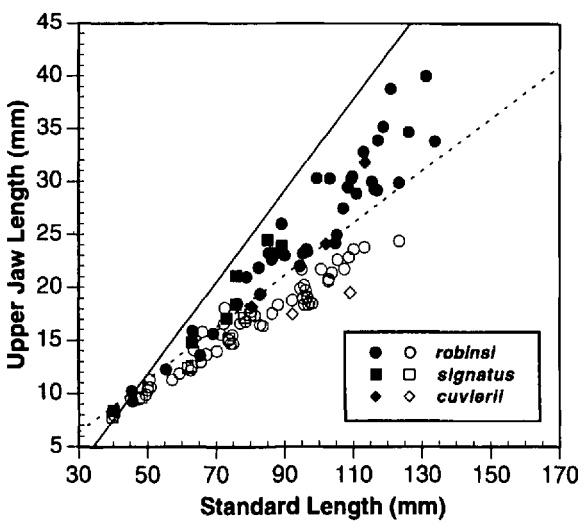

Figure 16. Relationship between upper jaw length versus standard length in *Opistognathus cuvierii, O. robinsi,* and *O. signathus*. Solid symbols = males; open symbols = females. Solid and dashed regression lines are those of *Opistognathus macrognathus* males and females, respectively (see Fig. 15).

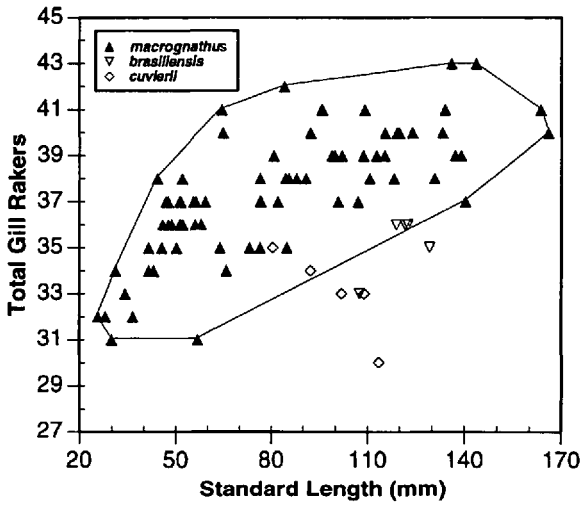

Figure 17. Relationship between number of total gill rakers versus standard length in *Opistognathus macrognathus, O. brasiliensis* and *O. cuvierii.*

straight and slightly rounded posterodorsally, not consisting of a broad truncated flap; dorsalmost spine of opercle noticeably elongate (Fig. 8c); posterior margin of preopercle indistinct, with at most a slight groove dorsally. No papillae on inner surface of lips. Fifth cranial nerve passes over A1β section of adductor mandibulae muscle.

Upper jaw sexually dimorphic (Figs. 14a–b, 15), extending 0.5–1.1 eye diameters behind orbit in adult females versus 0.8–2.3 in adult males, with a flexible lamina posteriorly (best developed in adult males); end of maxilla approximately truncate (juveniles), slightly rounded (females), becoming increasingly elongate, and scimitar-shaped (adult males); supramaxilla present and subterminally positioned. Coronoid (ascending) process of articular tilted slightly backward and club-shaped (Figs. 14a–b). Premaxilla anteriorly with outer row of stout teeth and two irregular inner rows of strongly recurved teeth; outer-row teeth largest anteriorly and slightly curved outward, becoming nearly straight laterally with recurved tips. Dentary anteriorly with an outer row of stout teeth (those projecting outward interlock slightly and visible when mouth is closed) and an inner series of 2–3 irregular rows of teeth, those of innermost series strongly recurved; outer teeth moderately curved anteriorly becoming more erect laterally, with posterior 3–5 teeth slightly enlarged and strongly incurved. Vomer with 1or 2 large teeth. Infraorbital bones tubular, with only moderate openings for sensory canals (Fig. 14c); third infraorbital with a moderate suborbital shelf. Postcleithra consisting of two well separated bones; dorsal postcleithrum thin and disk-shaped, ventral postcleithrum rod-shaped with pointed ends (Fig. 14d).

Selected measurements of 27 females (51.1–133.2 mm SL) and 33 males (51.6–166 mm SL) as percent SL, sample sizes in parentheses: head length 32.2–44.0 (57); postorbital head length 52.2–63.1 (30); orbit diameter 9.9–13.5 (57); upper jaw 19.3–24.7 (25, females) and 23.5–38.7 (32, males); pelvic fin length 14.8–21.8 (46); caudal fin length 16.9–22.1 (46); predorsal length 28.1–34.8 (46); preanal length 51.5–69.3 (46); dorsal-fin base 62.1–71.3 (17); anal-fin base 32–38.1 (17); depth anal-fin origin 16.9–23.8 (46); caudal peduncle depth 8.6–10.9 (46). Selected measurements as percent HL: postorbital head length 52.2–63.1 (30);

orbit diameter 27.8–39.4 (58); upper jaw length 56.6–70.1 (26, females) and 64–106 (32, males); postorbital jaw length 19.2–32.9 (10, females) and 25.7–80.2 (16, males).

Coloration.—In preservation, as shown in Figure 10; inner maxillary and adjacent membranes with sexually dichromatic black stripes (Fig. 9c); conspicuous buccal pigmentation present as described in diagnosis.

In life, body and fins grayish olive to pale tan, variegated with pale yellowish blotches and dusky markings; body with two rows of 5 or 6 dark brown blotches, the first on on mid-sides, the second along back and extending into base of dorsal fin; blotches of the two rows sometimes conjoined although individual blotches usually evident; oblong black spot in outer half of spinous dorsal fin, usually between spines 7–10; head and base of pectoral fin marbled with brown, dorsum of head and especially proximal half of pectoral fin speckled with small black dots; caudal fin usually with a pair of pale basicaudal spots; underside of maxilla and adjacent membranes of males with two black stripes (one stripe in females), conspicuousness of stripes enhanced by brillant white area between them and on inner margin of maxilla; males with shorter orange stripe, which is not evident in preservation, along inner margin of innermost black stripe (life coloration of inner jaw in females unknown); iris brown.

Etymology.—The trival name is derived from the Greek *makros* (long) and *gnathos* (jaw). The recommended common name (Robins et al., 1991) is banded jawfish.

Remarks.—Robins et al. (1991) placed Poey's name in parentheses, thus implying that the generic name assigned to *O. macrognathus* in the orginal description differs from that currently used. As discussed by Briggs (1961), the one letter variant spelling "*Opisthognathus*" is a misspelling of the original generic name proposed by Cuvier (1836:252). Article 51c of the International Code of Zoological Nomenclature states that the use of parentheses "is not affected . . . by emendation of the generic name." Based on the above statement and examples given in the Code, parentheses are to be used to indicate a change in *classification* and not a subsequent misspelling or variant spelling of a generic name.

Although Poey's type material of *O. macrognathus* can not be located, the original description clearly applies to the species as currently recognized. Especially diagnostic is Poey's illustration (pl. 18, fig. 7) of the underside of the upper jaw showing a pair of black stripes.

Distribution (Fig. 19).—Florida, Gulf of Mexico, and Bahamas to northern South America, including the Lesser Antilles in depths of 0.5–44 m.

Material Examined.—97 specimens, 3.6–166 mm SL. GULF OF MEXICO: BMNH 1855.9.19.34 (2, 118–139, syntypes of *O. megastoma*). FLORIDA: ANSP 138458 (1, 82); ANSP 138465 (2, 76–84); ANSP 138599 (15, 3.6–57, 1 C&S); CAS 15797 (1, 79); UF 35663 (1, 77); UF 100053 (5, 34–52); UF 216659 (1, 131); UF 218886 (1, 28); UF 219023 (1, 37); UF 219667 (2, 46–51); UF 227129 (1, 115); UF 228401 (1, 64); UMMZ 199013 (1, 37); USNM 5936 (107, holotype of *O. scaphiurus*); USNM 108873 (51.6, holotype of *O. fasciatum*); USNM 109312 (12, 26–59). BAHAMAS: ANSP 78828 (1, 138); ANSP 138367 (1, 47); UF 201171 (4, 51–101); USNM 197893 (1, 115); USNM 198782 (1, 100). CUBA: MCZ 12514 (110.2, holotype of *O. macrops*). PUERTO RICO: ANSP 134244 (2, 31–92); ANSP 134245 (1, 111); ANSP 134246; ANSP 141704 (2, 70–86); ANSP 142092 (3, 44–86, 1 C&S); UPRM 2628 (1, 66). VIRGIN IS.: UF 205155 (3, 44–56); UF 207400 (1, 77); UF 20 9097 (1, 84); UPRM 1100 (1, 96). GRENADA: BMNH 1904.3.15.34 (1, 64). VENEZUELA: ANSP 101795 (1, 73); ANSP 105163 (1, 85); ANSP 105305 (1, 119); ANSP 105679 (1, 113); ANSP 120191 (1, 120); ANSP 138457 (1, 96; 2, 77–86 C&S); ANSP 138459 (2, 133–166); ANSP 159313 (2, 102–134); UF 219261 (2, 136–144); USNM 178040 (1, 140); USNM 217805 (1, 52). PANAMA: SIO 71-256 (3, 99–124). COLOMBIA: ANSP 138466 (2, 81–109); UF 228819 (1, 65).

Table 9. Morphometric data, expressed as percentages of standard length or head length (*), for types of *Opistognathus brasiliensis*

	Holotype		Paratypes		
Standard length (mm) sex	107.5 ♀	121.7 ♀	118.9 ♂	122.5 ♂	129.2 ♂
Predorsal length	32.8	38.3	37.5	39.3	40.6
Preanal length	58.5	69.6	64.2	64.0	65.5
Dorsal-fin base	63.0	70.0	71.6	70.8	77.6
Anal-fin base	36.7	41.6	41.4	42.7	43.4
Pelvic fin length	24.4	24.1	24.6	26.1	25.8
Caudal fin length	23.7	26.9	25.6	25.3	27.6
Depth anal-fin origin	22.9	21.4	25.0	27.4	26.6
Caudal peduncle depth	10.1	11.6	11.3	12.8	12.1
Length 5th dorsal spine	16.2	19.5	20.5	14.2	16.8
Length 5th dorsal ray	18.0	21.6	22.9	19.3	20.7
Head length	35.9	35.7	37.4	38.8	37.5
Postorbital head length	20.1	24.4	26.0	26.5	27.2
Orbit diameter	11.3	12.6	10.3	13.2	13.3
Upper jaw length	23.6	25.9	42.8	41.9	44.6
*Postorbital head length	56.0	67.9	72.5	73.8	75.6
*Orbit diameter	31.6	31.0	27.4	30.0	29.5
*Upper jaw length	65.7	72.0	119.2	116.6	124.1
*Postorbital jaw length	21.6	27.2	76.4	74.6	74.1

Opistognathus brasiliensis new species
Figures 9c, 13b, 15, 17, 20; Tables 2–5, 8–9

Opisthognathus cuvieri (*non* Valenciennes). Thommasi, 1961:29 (description; Alcatraces Island, near Sao Paulo).

Diagnosis.—A species of *Opistognathus* distinguished from all others by the following combination of characters: anterior nostril a short tube with simple cirrus on posterior rim; posterior end of maxilla of adults males produced as a thin flexible lamina that usually extends beyond posterior margin of opercle; spinous dorsal fin with black spot encircled by a very narrow white ring; dorsal fin with 5 or 6 dusky bands that extend onto dorsum; adult males with inner lining of maxilla and adjacent membranes with two dark stripes, one stripe in females; pectoral fin uniformly pigmented, no black speckles proximally; buccal pigmentation consisting of a dark area widely surrounding esophageal opening except for pale area posteriorly that continues between upper pharyngeal tooth patches (Fig. 13b); caudal vertebrae 18.

Description.—Dorsal fin XI, 16. Anal fin III, 15 or 16. Pectoral-fin rays 18 or 19. Caudal fin: procurrent rays 4–5+3–4, segmented rays 8 + 8, middle 12 branched, total elements 23–25; hypural 5 absent. Vertebrae: 10 + 18; last pleural rib on vertebra 10, epineurals 14 or 15. Supraneural bones 2. Gill rakers 9–11 + 23 or 24 = 33–36.

Scales absent on head, nape, pectoral-fin base and breast; belly completely scaled, except for small area behind pelvic bases, and sides fully scaled including area above lateral line, which has 1–2 rows anteriorly and 3 rows posteriorly. Body with 59–75 oblique scale rows in longitudinal series. Lateral-line terminus below verticals between 2nd and 4th segmented dorsal-fin rays. Anterior lateral-line pores relatively sparse, arranged in unbranched series and positioned very close to lateral-line tubes, all of which are embedded in skin. Mandibular pore positions mostly consisting of multiple pore series, except first two mandibular pore positions occupied by simple pores; preopercular pore positions mostly oc-

cupied by simple pores, a few bipored in large specimens. Infraorbital pore positions mostly consisting of multiple series, which extend moderately onto cheeks. Pores on nape moderately developed, unpored median predorsal area approximately one eye diameter in length.

Anterior nostril closer to posterior nostril than to dorsal margin of upper lip, consisting of short tube with simple, flattened posterior cirrus which reaches anterior margin of orbit when depressed; height of cirrus 4–8 times maximum diameter of posterior nostril. Dorsal fin moderately high anteriorly, with posterior rays slightly longer; profile relatively uniform without noticeable change in fin height at junction of spinous and segmented rays; dorsal-fin spines slender, usually curved distally, with flexible tips; all segmented dorsal- and anal-fin rays branched distally. Outermost segmented pelvic-fin ray not tightly bound to adjacent ray, interradial membrane strongly incised distally; pelvic fin not elongate in adults, tip of depressed fin in front of anal-fin origin. Upper margin of subopercle straight and slightly rounded posterodorsally, not consisting of a broad truncated flap; posterior margin of preopercle indistinct, with at most a slight groove dorsally. No papillae on inner surface of lips. Fifth cranial nerve passes over A1β section of adductor mandibulae muscle.

Upper jaw sexually dimorphic (Fig. 15), extending about 0.75 eye diameters behind orbit (in adult females) versus 2.0–2.4 (in adult males), with a flexible lamina posteriorly (best developed in adult males); end of maxilla slightly rounded (females), becoming increasingly elongate, and scimitar-shaped (adult males); supramaxilla present and subterminally positioned. Coronoid (ascending) process of articular tilted slightly backward and club-shaped. Premaxilla anteriorly with stout outer-row teeth and an irregular inner row of teeth that are strongly slanted backwards and almost horizontally positioned; outer-row teeth larger anteriorly and slightly curved outward, becoming nearly straight laterally with recurved tips. Dentary anteriorly with stout outer-row teeth (which interlock slightly and are visible when moth is closed) and an inner irregular series of strongly recurved teeth; outer teeth moderately curved anteriorly becoming more erect laterally, with posterior 3–5 teeth slightly enlarged and strongly incurved. Vomer with 1–3 large teeth.

Coloration.—Dorsal fin with 5 or 6 dark bands proximally that extend onto dorsum to or slightly below lateral line; interspaces between anterior bands about equal width of individual bands, but slightly wider than widths of posterior two bands; spinous dorsal fin with darker spot, encircled by very narrow pale ring, between spines 4–7; distal half of soft dorsal, anal, and pelvic fins uniformly dark, paler proximally; caudal fin uniformly dusky without evidence of basicaudal pale spots (absence of basicaudal spots, if true for all specimens, is an autapomorphy that distinguishes *O. brasiliensis* from other members of the *O. macrognathus* species group); pectoral-fin base with pale spots, and pectoral fin uniformly pale. Head uniformly pigmented except for dark band crossing nape and extending to dorsal margin of preopercle; inner maxillary and adjacent membranes with sexually dichromatic black stripes (Fig. 9c), outermost black stripe outlining posteroventral margin of maxilla visible laterally in males; conspicuous buccal pigmentation present as described in the diagnosis.

The only record of life coloration is Tommasi's (1961) brief description of the species (as *O. cuverii*): body "chestnut, the dorsal, anal, and caudal fins with dark borders, like the maxilla."

Etymology.—The trival name refers to Brazil, along whose coast this species

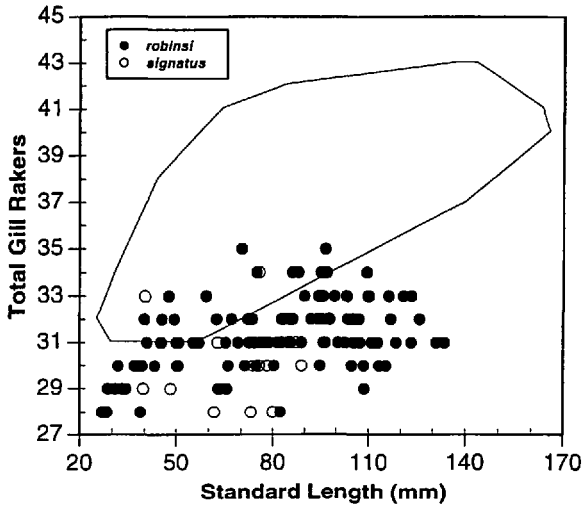

Figure 18. Relationship between number of total gill rakers versus standard length in *Opistognathus robinsi* and *O. signatus*. Envelope encloses range of total gill rakers observed in *Opistognathus macrognathus* (see Fig. 17).

appears to be endemic. The common name darkfin jawfish is suggested for this species.

Distribution (Fig. 19).—Known only from southern Brazil, where trawled in depths of 50–69 meters.

Material Examined.—5 specimens, 107.5–129.2 mm SL. Holotype: MZUSP 13257, female, 107.5 mm SL, Brazil, 23°44'S, 44°30'W, trawled in 62–69 m, 15 Jan 1970, R/V PROFROF. W. BRESNARD. Paratypes: MZUSP 13258–9 (2, 119–122), São Paulo, Alcatraces Is., 24°06'S, 45°42'W, 50 m, 21 Aug 1958. MZUSP 13260 (1, 129), 25°20'S, 47°05'W, 59–60 m, 14 Dec 1969. ANSP 141861 (1, 123), "southeastern Brazil," 1974.

Opistognathus cuvierii Valenciennes, 1836
Figures 9d, 13c, 16, 17, 21; Tables 2–5, 8

Opisthognathus cuvierii Valenciennes *in* Cuvier and Valenciennes, 1836:504, color pl. 343 (orig. descr.: Bahia; holotype MNHN A. 2108); Roux, 1964:413, pl. 10 (listed; original illustration of type reproduced).

Opisthognathus cuvieri. Günther, 1860:256 (compiled); Pinto, 1970:3 (description).

Opistognathus cuvieri. Roux, 1973:151 (description; CALYPSO station 119); Menezes and Figueiredo, 1985:42, fig. 47 (description).

Gnathypops cuvieri. Jordan and Evermann, 1898:2284 (compiled); Ribeiro, 1915:2 (compiled); Jordan, Evermann and Clark, 1930:452 (listed); Fowler, 1941:178 (listed).

Diagnosis.—A species of *Opistognathus* distinguished from all others by the following combination of characters: anterior nostril a short tube with simple cirrus on posterior rim; posterior end of maxilla of adults males produced as a thin flexible lamina that usually extends beyond posterior margin of opercle; spinous dorsal fin with a dark spot encircled by broad white ring; adult males with inner lining of maxilla and adjacent membranes with two dark stripes (innermost stripe not well developed), no stripes in females; buccal pigmentation consisting of a dark blotch on either side of esophageal opening widely separated by pale median area that continues between upper pharyngeals (Fig. 13c); caudal vertebrae 19.

Description.—Dorsal fin XI, 16. Anal fin III, 16. Pectoral-fin rays 18 or 19.

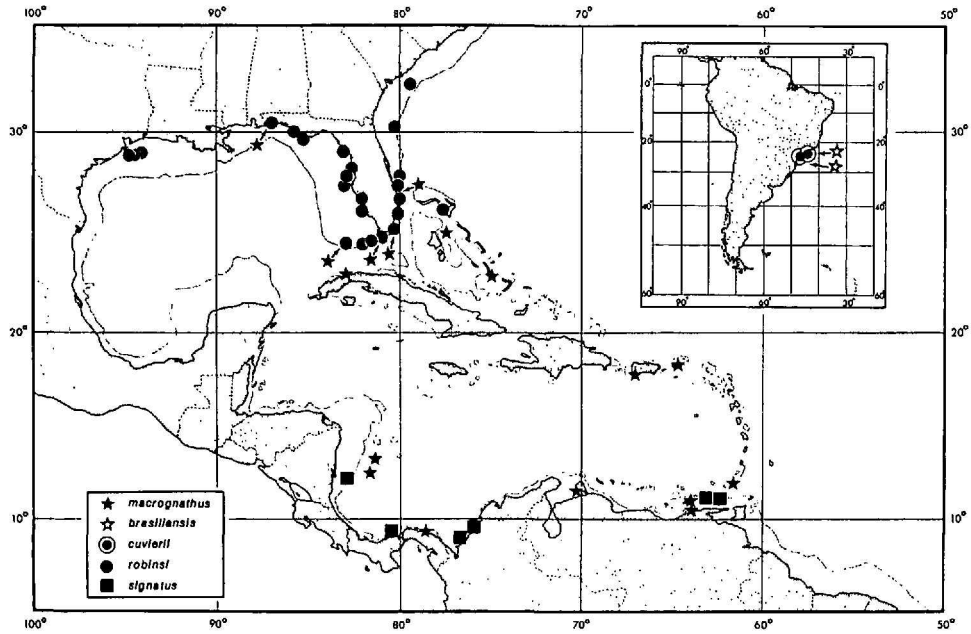

Figure 19. Distributions of *Opistognathus macrognathus, O. brasiliensis, O. cuvierii, O. robinsi,* and *O. signatus.*

Caudal fin: procurrent rays 3+2–3, segmented rays 8 + 8, middle 12–14 branched, total elements 21 or 22; hypural 5 absent. Vertebrae: 10 + 19; last pleural rib on vertebra 10, epineurals 10–12. Supraneural bones 1 or 2, anteriormost minute if present. Gill rakers 9–11 + 20–23 = 30–35.

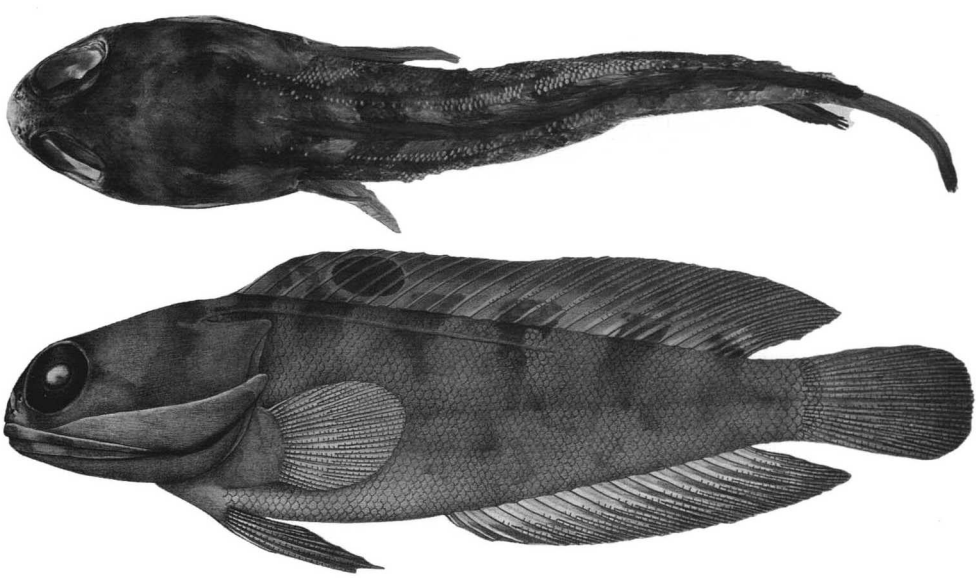

Figure 20. Dorsal and lateral views of *Opistognathus brasiliensis,* ANSP 141861, 122.5 mm SL, male, southeastern Brazil (lateral view drawing by Jack R. Schroeder).

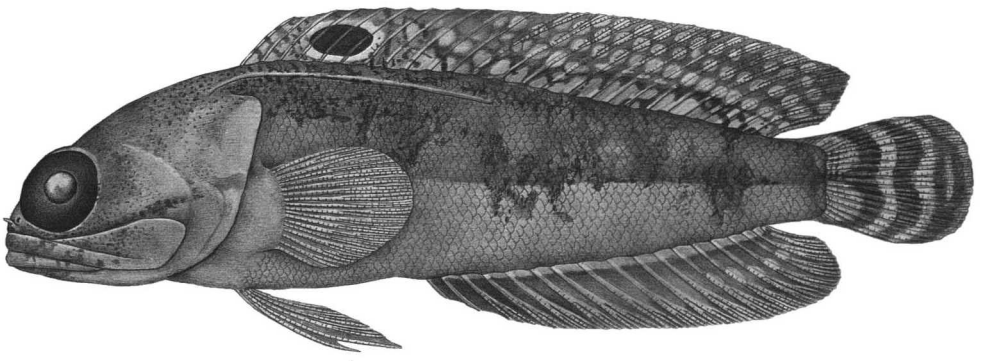

Figure 21. *Opistognathus cuvierii,* CAS-SU 52354, 102 mm SL, male, Brazil, Bahia (drawn by Jack R. Schroeder).

Scales absent on head, nape, pectoral-fin base and breast; belly completely scaled, except for small area behind pelvic bases, and sides fully scaled except for short area anteriorly above lateral line. Body with 60–72 oblique scale rows in longitudinal series. Lateral-line terminus below vertical from 2nd segmented dorsal-fin ray. Anterior lateral-line pores relatively sparse, arranged in unbranched series and positioned very close to lateral-line tubes, all of which are embedded in skin. Mandibular pore positions mostly consisting of multiple pore series, except first two mandibular pore positions occupied by simple pores; preopercular pore positions mostly occupied by simple pores, a few bipored in larger specimens. Infraorbital pore positions consisting of multiple series, which extend moderately onto cheeks. Pores on nape moderately developed, unpored median predorsal area approximately one eye diameter in length.

Anterior nostril about mid-way between dorsal margin of upper lip and anterior margin of orbit or positioned slightly closer to latter, consisting of short tube with simple, flattened, posterior cirrus which usually reaches anterior margin of orbit when depressed; height of cirrus 1.5–2.0 times maximum diameter of posterior nostril. Dorsal fin moderately high anteriorly, with posterior rays slightly longer; profile relatively uniform without noticeable change in fin height at junction of spinous and segmented rays; dorsal-fin spines slender, usually curved distally, with flexible tips; all segmented dorsal- and anal-fin rays usually branched distally. Outermost segmented pelvic-fin ray not tightly bound to adjacent ray, interradial membrane strongly incised distally; pelvic fin not elongate in adults, tip of depressed fin in front of anal-fin origin. Upper margin of subopercle straight and slightly rounded posterodorsally, not consisting of a broad truncated flap; posterior margin of preopercle indistinct, with at most a slight groove dorsally. No papillae on inner surface of lips. Fifth cranial nerve passes over A1β section of adductor mandibulae muscle.

Upper jaw sexually dimorphic (Fig. 16), extending about 0.5 eye diameters behind orbit (in adult females) versus 0.7–1.4 (in adult males), with a flexible lamina posteriorly (best developed in adult males); end of maxilla slightly rounded (females), becoming increasingly elongate, and scimitar-shaped (adult males); supramaxilla present and subterminally positioned. Coronoid (ascending) process of articular tilted slightly backward and club-shaped. Premaxilla anteriorly with stout outer-row teeth and two irregular, inner rows of strongly recurved teeth; outer row teeth largest anteriorly and slightly curved outward, becoming nearly straight laterally with recurved tips. Dentary anteriorly with outer row of stout teeth

(which interlock slightly, and are usually visible when the mouth is closed) and two irregular rows of strongly recurved inner teeth; outer teeth moderately curved anteriorly becoming more erect laterally, with the posterior 3–5 teeth slightly enlarged and incurved. Vomer with 2 large teeth.

Selected measurements of 2 females (92.3–109 mm SL) and 3 males (80.5–113.5 mm SL) as percent SL: head length 32.3–35.5; postorbital head length 19.6–21.1; orbit diameter 9.1–11.3; upper jaw 17.9–19.0 (females) and 22.6–28.0 (males); pelvic-fin length 16.9–20.0; caudal-fin length 18.2–20.2; predorsal length 32.3–35.5; preanal length 52.1–55.8; dorsal-fin base 62.4–68.5; anal-fin base 37.6–40.1; depth anal-fin origin 20.4–24.0; caudal peduncle depth 8.3–10.0; length 5th dorsal spine 9.0–15.5; length 5th dorsal ray 13.1–23.5. Selected measurements as percent HL: postorbital head length 59.4–62.4; orbit diameter 28.8–34.6; upper jaw length 54.2–57.9 (females) and 63.6–81.1 (males); postorbital jaw length 15.3–17.9 (females) and 23–40.8 (males).

Coloration.—In preservation, as shown in Figure 20; body and head, especially dorsum, brownish with dark reticulations and speckles; lips mottled and banded, brownish stripe parallel to dorsal margin of upper jaw usually extends across cheeks and opercle; spinous dorsal fin with a prominent ocellus between spines 3–7, dorsal fin otherwise with rows of pale spots and mottled with brown; anal fin mostly dark with row of pale spots posteriorly; caudal fin dark except for a pair of pale basicaudal spots followed by two pale bands; pelvic fins uniformly dark and pectoral fins immaculate; inner maxillary and adjacent membranes with sexually dichromatic black stripes (Fig. 9d); conspicuous buccal pigmentation present as described in diagnosis.

In the original description the color of some of the dark markings were described as reddish brown and the spinous dorsal-fin spot as deep blue encircled by a white ring.

Etymology.—Named in honor of the famous French ichthyologist Georges Cuvier (1769–1832) who with his pupil and successor, Achille Valenciennes, produced the monumental *Histoire Naturelle des Poissons.* The common name bartail jawfish is suggested for this species.

Comparisons.—*Opistognathus cuvierii* is superficially similar to the eastern Pacific *O. scops* (Jenkins and Evermann), see Instituto Nacional de Pesca, 1976, fig. 382; Thomson et al., 1979, fig. 82; Allen and Robertson, 1991, fig. 3, including buccal pigmentation consisting primarily of a dark bloch on either side of esophageal opening widely separated by pale median area that continues between upper pharyngeals. However, *O. scops* differs in having an additional small dark spot at the anterior base of each upper pharyngeal, a different pattern of dark maxillary stripes (two in males and one in females), typically 20 caudal vertebrae, and more oblique scale rows, "about 120–125" according to Allen and Robertson (1991).

Distribution (Fig. 19).—Known only from southern Brazil.

Material Examined.—5 specimens, 80.5–113.5 mm SL. MNHN A.2108 (109, holotype of *O. cuvierii*); NMW 60173 (1, 81); CAS-SU 52354 (1, 102). MNRJ 9838 (1, 114), MZUSP 10188 (1, 92).

Opistognathus robinsi new species

Figures 8d, 9e, 13d, 16, 18, 22–23, 24a, 25, 28–29; Tables 2–5, 8, 10

Opistognathus macrognathus (*non* Poey). Bailey et al., 1970:47 (common name "spotfin jawfish"); Goodson, 1976:166 (unnumbered fig.); Smith, 1976:36 (eastern Gulf of Mexico distribution).
Opisthognathus macrognathus (*non* Poey). Zeiller, 1975:105, fig. 226 (color photograph);

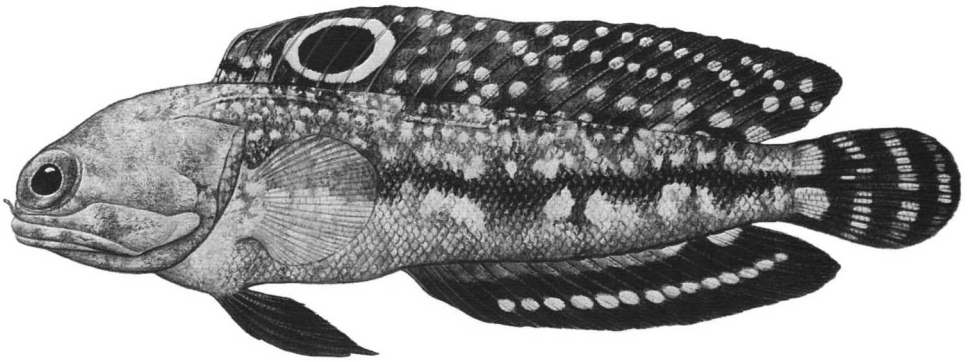

Figure 22. *Opistognathus robinsi,* ANSP 138478, 105.6 mm SL, holotype, male, Florida, Pinellas Co., Belle Vista Beach (drawn by Tracy D. Pedersen).

Opistognathus cuvieri (*non* Valenciennes). Starck, 1968:28 (misidentification; Alligator Reef, Florida); Bailey et al., 1970:47 (common name "phantom jawfish").

Opistognathus sp. Robins et al., 1980:50 (common name "spotfin jawfish"); Gilmore et al., 1981: 21 (listed from offshore reefs adjacent to Indian River Lagoon, Florida); Robins and Ray, 1986: 217, color pl. 43 (brief descr.); Smith-Vaniz and Böhlke, 1991:198 (Little Bahama Bank record).

Diagnosis.—A species of *Opistognathus* with the following combination of characters: anterior nostril a short tube with simple cirrus on posterior rim; posterior end of maxilla of adult males produced as a thin flexible lamina that usually

Figure 23. *Opistognathus robinsi,* female, ca. 80 mm SL, Biscanye Bay, Florida (aquarium photograph by Patrick L. Colin).

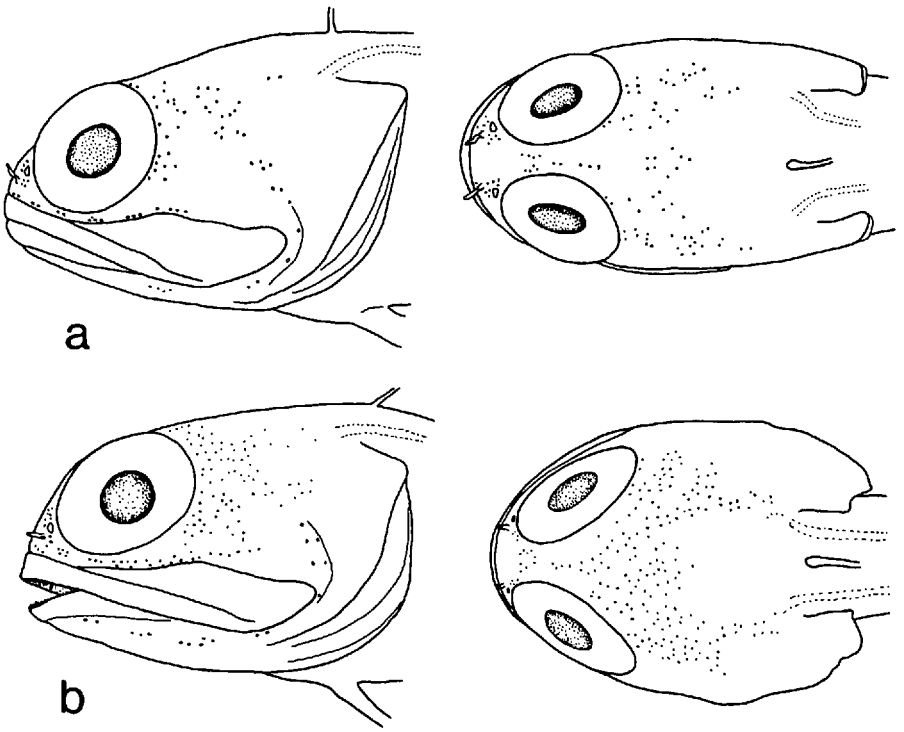

Figure 24. Physiognomy of head and cephalic sensory pores (lateral line pores not shown) in a, *Opistognathus robinsi*, UF 45104, 86.2 mm SL, male, Florida, Jupiter Inlet vicinity; b, *Opistognathus signatus*, ANSP 138472, 75.8 mm SL, male, Venezuela.

extends beyond posterior margin of opercle; spinous dorsal fin with black spot encircled by broad white ring; adult males with inner lining of maxilla and adjacent membranes with prominent black stripe (stripe usually absent or light brown and poorly developed in females); buccal pigmentation consisting of a large dark area widely surrounding esophageal opening, including medial area between upper pharyngeal tooth patches (Fig. 13d); caudal vertebrae typically 20. Further distinguished from its presumed sister-species, *Opistognathus signatus*, with which it shares the above character states, by having more oblique scale rows (73–88, $\bar{x}$ 79.5 versus 57–70, $\bar{x}$ 63.5), usually smaller eyes (Figs. 24a, 28), and absence of a prominent dark spot on a few scattered body scales.

Description.—Dorsal fin X or XI (rarely X), 15–18 (usually 17), = 26–29 total. Anal fin II or III (typically III), 16–18. Pectoral-fin rays 18–21. Caudal fin: procurrent rays 3–4+3–4, segmented rays 8+8, middle 12–14 branched, total elements 22–24; hypural 5 absent. Vertebrae: 10 + 19–21 (typically 20); last pleural rib on vertebra 10; epineurals 9–12. Supraneural bones 1 or 2, anterior supraneural minute or absent. Gill rakers (in adults number not increasing with increase in SL, see Fig. 18) 8–12 + 19–25 = 28–35.

Scales absent on head, nape, pectoral-fin base and breast; belly completely scaled, except for small area behind pelvic bases, and sides fully scaled except for area anteriorly above lateral line. Body with 73–88 oblique scale rows in longitudinal series. Lateral-line terminus below verticals from lst to 5th segmented dorsal-fin rays. Anterior lateral-line pores relatively sparse, arranged in unbranched

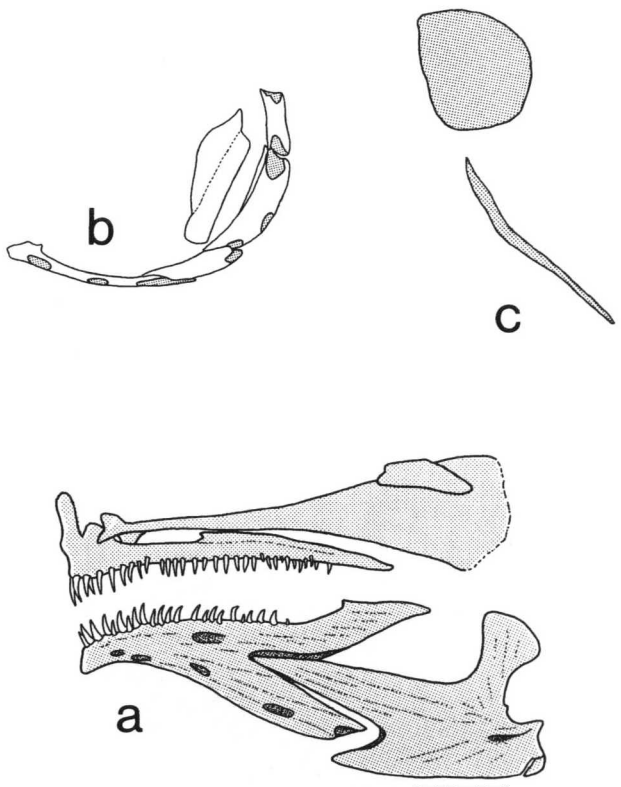

Figure 25. Selected bones in lateral views of *Opistognathus robinsi,* ANSP 138566, 92 mm SL, female : a, upper and lower jaws; b, infraorbital bones (3rd infraorbital also in rotated dorsal view); c, dorsal and ventral postcleithra.

series and positioned very close to lateral-line tubes, all of which are embedded in skin. Mandibular pore positions mostly consisting of multiple pore series, except first two mandibular pore positions occupied by simple pores; preopercular pore positions mostly occupied by simple pores, a few sometimes bipored in larger specimens. Infraorbital pore positions consisting of multiple series, which extend

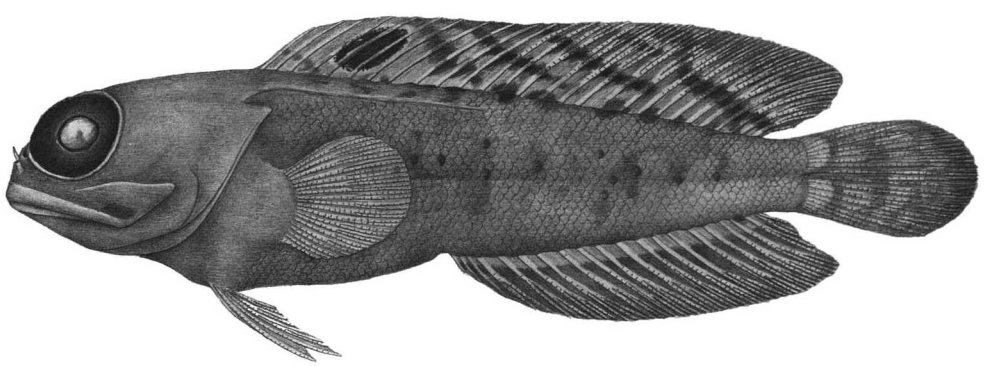

Figure 26. *Opistognathus signatus,* ANSP 138390, 87.3 mm SL, male, Panama, Golfo de los Mosquitos (drawn by Jack R. Schroeder).

Figure 27. *Opistognathus signatus,* ANSP 138471, 63 mm SL, female, Nicaragua, off Bluefields; aquarium photograph of recently trawled specimen.

moderately onto cheeks. Pores on nape moderately developed, unpored median predorsal area approximately one eye diameter in length (Fig. 24a).

Anterior nostril positioned about mid-way between dorsal margin of upper lip and anterior margin of orbit, consisting of short tube with simple, flattened, posterior cirrus which usually reaches anterior margin of orbit when depressed; height of cirrus 1.0–1.5 times maximum diameter of posterior nostril. Dorsal fin moderately high anteriorly, with posterior rays slightly longer; profile relatively uniform without noticeable change in fin height at junction of spinous and segmented rays; dorsal-fin spines slender, usually curved distally, with flexible tips; all segmented dorsal- and anal-fin rays usually branched distally, occasionally 1st ray unbranched. Outermost segmented pelvic-fin ray not tightly bound to adjacent ray, interradial membrane strongly incised distally; pelvic fin not elongate in adults, tip of depressed fin in front of anal-fin origin. Upper margin of subopercle straight and slightly rounded posterodorsally, not consisting of a broad truncated flap; dorsalmost spine of opercle noticeably elongate (Fig. 8d); posterior margin of preopercle indistinct, with at most a slight groove dorsally. No papillae on inner surface of lips. Fifth cranial nerve passes over A1β section of adductor mandibulae muscle.

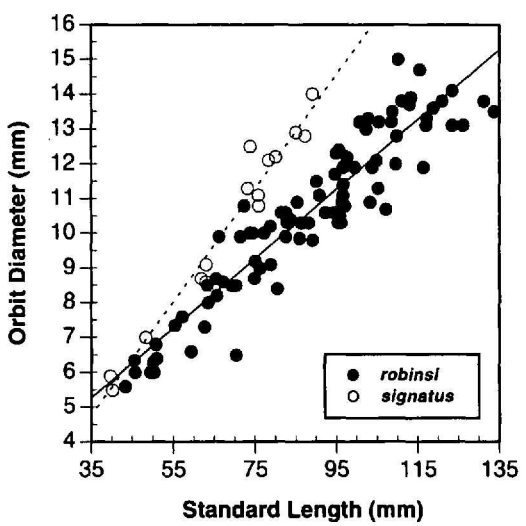

Figure 28. Relationship between orbit diameter versus standard length in *Opistognathus robinsi* and *O signatus.* Regressions slopes of the two populations are significantly different (P<.001).

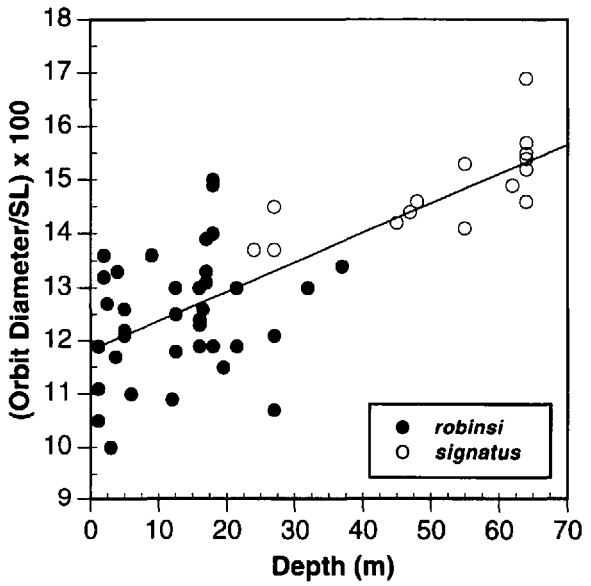

Figure 29. Scatter plot and regression (R^2=0.56) of relative orbit diameter versus depth in *Opistognathus robinsi* and *O. signatus*, symbols as in Fig. 28; minimum depth values were used for trawled specimens.

Upper jaw sexually dimorphic (Fig. 16), extending 0.4–0.7 eye diameters behind orbit (in adult females) versus 0.8–1.9 (in adult males), with a flexible lamina posteriorly (best developed in adult males); end of maxilla approximately truncate (juveniles), slightly rounded (females), becoming increasingly elongate, and scimitar-shaped (adult males); supramaxilla present and subterminally positioned. Coronoid (ascending) process of articular tilted slightly backward and club-shaped (Fig. 25a). Premaxilla anteriorly with outer row of stout teeth and two irregular inner rows of teeth, innermost strongly recurved; outer teeth largest anteriorly and slightly curved outward, becoming nearly straight laterally with recurved tips. Dentary anteriorly with outer row of stout teeth (which interlock slightly, and are visible when mouth is closed) and an inner series of 2–3 irregular rows of teeth, innermost series strongly recurved; outer teeth moderately curved anteriorly becoming more erect laterally, with the posterior 3–5 teeth slightly enlarged and strongly incurved. Vomer with 1–4 (rarely 5) large teeth. Infraorbital bones tubular, with only moderate openings for sensory canals (Fig. 25b); third infraorbital with a moderate suborbital shelf. Postcleithra consisting of two well separated bones; dorsal postcleithrum thin and disk-shaped, ventral postcleithrum rod-shaped with pointed ends (Fig. 25c).

Selected measurements of 43 females (62.5–123.4 mm SL) and 37 males (63.2–133.7 mm SL) as percent SL, sample sizes in parentheses: head length 29.4–38.8 (80); postorbital head length 16.3–22.4 (53); orbit diameter 9.2–15 (80); upper jaw 19.0–24.9 (43, females) and 20.8–32.1 (37, males); pelvic fin length 17.1–24.5 (69); caudal fin length 18.1–23.5 (65). Selected measurements as percent HL: postorbital head length 49.8–64.2 (53); orbit diameter 28.0–40.0 (80); upper jaw length 55.4–75.1 (43, females) and 60.2–95.1 (37, males); postorbital jaw length 8.0–25.5 (22, females) and 25.2–58.1 (19, males). Complete morphometric data for 17 males and 15 females are given in Table 10.

Table 10. Morphometric data, expressed as percentages of standard length or head length (*), for males and females of *Opistognathus robinsi*; values for holotype in parentheses

	Males (N = 17)				Females (N = 15)		
	Range		$\bar{x}$	SD	Range	$\bar{x}$	SD
Standard length (mm)	76.2–131.2	(103.2)	102.4	14.9	74.3–110.1	91.8	11.7
Predorsal length	28.2–34.2	(32.0)	31.3	1.8	29.0–34.9	32.0	1.8
Preanal length	50.6–61.0	(51.4)	54.1	2.6	48.4–56.6	53.9	2.4
Dorsal-fin base	62.9–73.7	(71.0)	67.9	2.9	65.0–71.0	68.2	2.0
Anal-fin base	35.6–43.0	(43.0)	40.4	2.0	37.1–43.7	40.0	1.8
Pelvic fin length	17.1–23.7	(22.1)	19.9	1.7	17.6–23.7	20.5	1.7
Caudal fin length	18.1–23.6	(23.5)	21.2	1.3	18.9–23.2	21.2	1.2
Depth anal-fin origin	17.5–23.5	(20.2)	20.9	1.5	18.9–24.3	21.0	1.4
Caudal peduncle depth	7.6–9.8	(9.7)	8.8	0.6	6.5–9.2	8.6	0.7

Coloration.—In preservation, as shown in Figure 22; body and head brownish, head and nape often with dark reticulations and speckles, and body with pale spots and blotches; spinous dorsal fin with a prominent ocellus between spines 3–7, otherwise dorsal fin dark except for pale spots which often form irregular, diagonal rows posteriorly; anal fin mostly dark, except for pale basal area which sometimes is superimposed with a row of pale spots, and row of pale spots also usually extends through distal third of fin; caudal fin dark except for a pair of pale basicaudal spots which are usually followed by 2 or 3 irregular, pale bands; pelvic fins uniformly dark and pectoral fins immaculate or with faint pale spots proximally; inner maxillary and adjacent membranes with a single black stripe in males, with stripe absent or weakly developed in females (Fig. 9e); conspicuous buccal pigmentation present as described in the diagnosis.

In life, the inner maxillary stripe and buccal pigmentation are jet black and the pale adjacent areas are brilliant white, as is the ring encircling the black spot in the spinous dorsal fin (Fig. 23); ground color of head, body, and fins ranges from light to dark brown to nearly black; pale blotches and spots white.

Etymology.—I take great pleasure in naming this species in honor of Dr. C. Richard Robins in recognition of his many and varied contributions to ichthyology, and as a token of my appreciation for his guidance as teacher, friend and colleague. The recommended common name (Robins et al., 1991) is spotfin jawfish.

Comparisons.—*Opistognathus robinsi* appears to be the allopatric sister-species of *O. signatus* (see discussion in following species account).

Distribution.—*Opistognathus robinsi* is essentially a continental species (Fig. 19), the only exception is one collection from the Little Bahama Bank. As discussed in the following species account, the distributional hiatus between *O. robinsi* and *O. signatus* may be a collecting artifact. Almost all collections of this species came from depths shallower than 20 m, including most of those cited below without depth of capture specified; the deepest record is a trawl collection from 37–46 m.

Material Examined.—109 specimens, 21–131 mm SL. Holotype: ANSP 138478 [formerly FDNR 3060], male, 105.6 mm SL, Florida, Pinellas Co., Belle Vista Beach, depth 1.2 m, 27 Apr 1964, Martin A. Moe, sta MM 64-7. Paratypes: BAHAMAS: AMNH 28297 (1, 59), Little Bahama Bank, Abaco Bight, 6 Dec 1966. SOUTH CAROLINA: ANSP 150953 (1, 118), SSE of Charleston Light, 32°30.4′N, 79°33.5′W, regurgitated by *Centropristis striata*, 20 m, 16 Feb 1983. FLORIDA: UF 23760 (1, 104) and UF 228575 (1, 131), no specific locality. *St. John's Co.*: USNM 217806 (1, 77), 30°14.5′N, 80°27′W, 32–34.5 m, 10 Apr 1963, R/V SILVER BAY sta 4917. *Indian River Co.*: UF 228905 (1, 105),

27°39.5′N, 80°08′W, 27 m, 28 Sep 1963, R/V SILVER BAY sta 5099. ANSP 138569 (1, 113), between Melbourne and Ft. Pierce, 19 km offshore, 27–30 m, 26 Mar 1964. *St. Lucie Co.*: Pepper State Park: UF 100046 (1, 21), 3 m, 14 Jul 1977; UF 100048 (1, 41), 3–5 m, 30 Jul 1976. UF 100047 (1, 96), Ft. Pierce Inlet, Jul 1958. *Martin Co.*: St. Lucie Inlet, 1.6 km S.; UF 100049 (6, 24–50), 5 m, 28 Aug 1977; UF 100050 (1, 50), 5 m, 29 Aug 1977. *Palm Beach Co.*: AMNH 9045 (1, 123), Palm Beach, 22 Mar 1927. AMNH 16834 (1, 105), Lake Worth, 2 May 1946. UF 45104 (2, 86–97), 1 km N of Jupiter Inlet, , 1.2 m, 9 Aug 1983. *Broward Co.*: UF 212344 (1, 97), intracoastal waterway at Harbor Beach, 15 Mar 1962; ANSP 138475 (1, 110), Ft. Lauderdale, 14 Aug 1962. *Dade Co.*: Biscayne Bay: ANSP 138566 (3, 92–70, C&S), CAS 40397 (2, 96–119), GCRL 15735 (2, 95–101), SIO 77–372 (2, 98–110), all from same collection, 1961; UF 206990 (1, 83), 24 Aug 1960; UF 37007 (1, 48), 3 m, 26 Jul 1958; UF 209159 (1, 95), 17 Mar 1961; UF 203181 (1, 64), 3 Jul 1958; UF 206262 (1, 74), 1.5 m, 20 Jul 1959. Dinner Key: UF 206819 (1, 80), 2 Apr 1958. Feather Bed Bank: ANSP 138476 (1, 82) 11 Feb 1965. Cutter Bank South: ANSP 122199 (3, 74–90), 25 Sep 1969. North Bay Is.: UF 209785 (1, 117), 21 Jan 1961; UF 228472 (1, 40), Jul 1948. Rickenbacker Causeway: UF 210012 (1, 126), 11 Jan 1962. Miami: CAS 14220 (1, 67). *Monroe Co.*: ANSP 138473 (1, 51), 24°49′N, 80°39′W, 37–46 m, 15 Sep 1965, R/V Gerda sta 753. UMMZ 199008 (1, 83), Long Key, 26 Jun 1961; UMMZ 199011 (2, 29–65), Long Key, 1.5 m, 7 Aug 1961. Key West: USNM 156671 (1, 63), 20 Oct 1919. Marquesas Keys vicinity: UF 37336 (1, 71), 24°42.28′N, 82°13.13′W, 15–19 m, 19 Apr 1983; UF 79699 (1, 86), 24°46′N, 82°04.9′W, 19.5 m, 22 Apr 1988. Dry Tortugas: ANSP 138477 (1, 111), 18 Jul 1956; UF 200214 (1, 109), 24°45′N, 82°10′W, 2 Jun 1956; UF 23813 (1, 95), 24°48′N, 82°37′N, 24 Apr 1977. *Collier Co.*: UF 37011 (1, 34), 26°24′N, 82°28′W, 18 m, 6 Aug 1967. UF 37012 (6, 27–43), 27°37′N, 83°05′W, 18 m, W, 25 Jul 1967. UF 74575 (1, 94), Marco Is., Factory Bay, 8 Aug 1974. *Lee Co.*: UF 37013 (1, 51), 26°24′N, 82°06′W, 16.5 m, 5 Aug 1967. *Charlotte Co.*: USNM 217807 (1, 123), Charlotte Harbor, Jul 1973. ANSP 70795 (1, 97), Lemon Bay, 30 Nov 1935. UMMZ 155075 (1, 116), Lemon Bay, 14 Aug 1937. USNM 156670 (1, 73), Gasparilla Light, 4 Jan 1913. *Sarasota Co.*: USNM 124385 (1, 117), Sarasoto, 6 Feb 1945. *Pinellas Co.*: 24–27 km off Johns Pass, Madeira Beach: ANSP 106130 (4, 45–72), 18 m, 21 Sep 1958; UF 37009 (1, 45), 18 m, 14 Sep 1958; UF 37008 (1, 39), 18 m, 9 Aug 1958; ANSP 151606 (2, 63–69), 6 Dec 1958. Coffeepot Bayou, Snell Isle Bridge: UF 37010 (1, 134), 25 Nov 1963. Clearwater Beach: UF 2593 (1, 121), 1950. Pass-a-Grille Beach: UMMZ 160901 (1, 113), before Mar 1942. *Pasco Co.*: ANSP 138474 (1, 97), 3 km off Pithlachoscottie River, Jul 1961. ANSP 151605 (2, 105–116), 11 km W of Hudson, Mar 1964. ANSP 15104 (1, 103), 8–13 km off Port Richey, 2.4–4 m, 3 Jun 1965. UF 37014 (1, 32), 28°05′N, 83°16′W, 16.5 m, 20 Jul 1967. *Hernando Co.*: ANSP 151607 (1, 57), 24 km off Aripeka, 4 m, 30 Oct 1960. *Citrus Co.*: UF 43069 (1, 110), off Crystal River, 15–20 mi offshore, 9–10.5 m, Apr 1985. UF 87969 (1, 75), Homossassa, 6 mi offshore, 29 May 1991. *Levy Co.*: Cedar Key: UF 5894 (1, 79), 14 May 1955; UF 5895 (1, 109), 5 m, 23 Mar 1957. UF 96305 (3, 66–81), ca. 3.5 km W. of Suwannee River mouth, 29°19.4′N, 83°31.2′W, 1.5 m, 4 Feb 1994, sta. SRR 21. *Dixie Co.* UF 78320 (1, 107), 10 km S of Steinhatchee River mouth, 1.5 km off shore, 13 May 1978. *Gulf Co.*: UF 69021 (1, 96), St. Joseph's Bay, 21 Jul 1971. *Bay Co.*: UF 65756 (1, 107), St. Andrews Bay, 0–6 m, 30 Mar 1968. *Santa Rosa Co.*: ANSP 151609 (1, 88), Santa Rosa Sound, 3.7 m, 30 May 1978. *Escambia Co.*: Pensacola Bay: ANSP 151608 (1, 89), 30°23′N, 87°15′W, 5–7 m, 9 Aug 1978; ANSP 151610 (1, 96), Navy turn basin, 12 m, 31 May 1978. FMNH 78650 (1, 95), Pensacola. TEXAS: off Galveston: ANSP 138565 (4, 75–99), 28°53′-55′N, 94°06.5′-09′W, 16–20 m, 8–11 Jun 1976; ANSP 144096 (2, 88–103), 28°51′N, 94°41′W, 21.5 m, 10 May 1979. Freeport: ANSP 149384 (1, 81), 19 km offshore, 28°43.20′N, 95°16.12′W, 21 m, 7 Jul 1979.

Opistognathus signatus new species
Figures 9e, 13d, 16, 18, 24b, 26–29; Tables 2–5, 8

Opistognathus sp. Palacio, 1974:67 (Colombian records).

Diagnosis.—A species of *Opistognathus* with the following combination of characters: anterior nostril with simple cirrus on posterior rim; posterior end of maxilla of adults males produced as a thin flexible lamina that usually extends beyond posterior margin of opercle; spinous dorsal fin with black spot encircled by broad white ring; adult males with inner lining of maxilla and adjacent membranes with a prominent black stripe (stripe usually absent or light brown and poorly developed in females); buccal pigmentation consisting of a large dark area widely surrounding esophageal opening, including medial area between upper pharyngeal tooth patches (Fig. 13d); caudal vertebrae 19 or 20, usually 20. Further distinguished from its presumed sister-species, *Opistognathus robinsi,* with which it

shares the preceding character states, by having fewer oblique scale rows (57–70, $\bar{x}$ 63.5 versus 73–88, $\bar{x}$ 79.5), a prominent dark spot on a few scattered body scales, and typically larger eyes (Figs. 24b–28).

Description.—Dorsal fin X or XI (rarely X), 16 or 17 = 27 or 28 total. Anal fin II or III (typically III), 16 or 17. Pectoral-fin rays 19–21. Caudal fin: procurrent rays 3–4+3–4, segmented rays 8+8, middle 12–14 branched, total elements 22–24; hypural 5 absent. Vertebrae: 10 + 19 or 20; last pleural rib on vertebra 10; epineurals 9–12. Supraneural bones 1 or 2, anteriormost supraneural minute or absent. Gill rakers (in adults number not increasing with increase in SL, see Fig. 18) 9–12 + 19–22 = 28–34. Body with 57–70 oblique scale rows in longitudinal series. Lateral-line terminus below verticals between lst to 3rd segmented dorsal-fin rays. Vomer with 1 or 2 large teeth. Except for characters discussed below, all others agree with those of *O. robinsi* and are not repeated here.

Morphometic data are within the ranges of *O. robinsi* except for larger orbit diameters in *O. signatus* (13.7–16.9% SL) versus 9.2–15.0 in *O. robinsi,* see below.

Coloration.—*Opistognathus signathus* and *O. robinsi* have identical buccal pigmentation (Fig. 13d), a presumed synapomorphy, and also agree in most other general features of their color patterns including sexually dichromatic intermaxillary markings. *Opistognathus signatus* differs from *O. robinsi* in having a few heavily pigmented, mid-lateral body scales, each appearing as an isolated, prominent dark spot. Preserved specimens generally have paler fins and bodies with fewer pale spots than do their northern counterparts, perhaps in part an artifact of preservation. The only record of life coloration in *O. signatus* is a kodachrome slide of a Nicaraguan female; that specimen (Fig. 27) has the isolated, dark, scale spots characteristic of other adults in combination with heavily pigmented and spotted dorsal, anal and caudal fins typical of *O. robinsi.* The illustrated specimen (Fig. 26) had the best color pattern of the preserved specimens (illustrated approximately 11 years after storage in isopropanol). While some of the apparent color pattern differences between the two species may be an artifact of preservation, none of the many specimens of *O. robinsi* (many of which have also had a long storage in isopropanol), exhibits the scale pigmentation pattern mentioned above.

Etymology.—The specific epithet is from the Latin *signatus* (marked), in reference to the prominent dark scale spots.

Comparisons.—*Opistognathus signatus* and *O. robinsi* differ in few characters and apparently have allopatric distributions (see below). They are here recognized as sister-species but their taxonomic status should be re-evaluated if specimens become available from the central American coast in the area between the known ranges of both species. In addition to the single color pattern difference discussed above and slightly fewer numbers of oblique body scale rows (Table 4), *O. signatus* has larger eyes (Fig. 24b, 28). However, *O. signatus* was trawled from depths of 27–68 m while most collections of *O. robinsi* were from much shallower depths, and this may partially account for the difference in eye diameters (Fig. 29).

Distribution.—Known only from coastal waters of Nicaragua, Panama, and Colombia (Fig. 19), based on a total of eight trawl collections all made by the R/V PILLSBURY in depths of 27 to 68 m. No comparable trawl collections are available

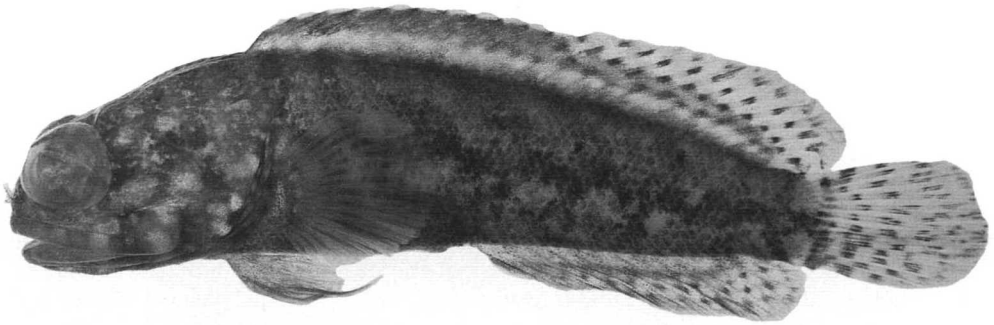

Figure 30. *Opistognathus whitehurstii,* UF 232926, 51 mm SL, female, Bahamas, Exuma Cays.

from the Central American coast north of Nicaragua, so the distributional hiatus between the ranges of *O. signatus* and *robinsi* could be only a collecting artifact.

Material Examined.—15 specimens, 39.7–89.1 mm SL. Holotype: ANSP 138390 [formerly UMML 23936], male, 87.3 mm SL, Panama, Golfo de los Mosquitos, 9°20.5'N, 80°13.5'W-09°19.6'N, 80°15.5'W, 64–68 m, 20 Jul 1966, R/V PILLSBURY sta 433. Paratypes: NICARAGUA: off Bluefields: ANSP 138471 (2, 48–63), 12°28.9'N, 83°04.8'W, 27 m, 28 Jan 1971, R/V PILLSBURY sta 1335. PANAMA: Golfo de los Mosquitos: ANSP 138467 (2, 74–89 + 1, 78 C&S), SIO 77–373 (1, 73), and USNM 217447 (1, 85), 9°20.5'N, all same data as holotype. UF 226655 (1, 63), 9°14.6'N, 80°21.8'W-9°13.5'N, 80°22.8'W, 47–49 m, 20 Jul 1966, R/V PILLSBURY sta 434. COLOMBIA: Golfo del Darien: UF 228490 (2, 62–80), 8°57.5'N, 76°33.6'W-9°0.3'N, 76°30.5'W, 55–64 m, 12 Jul 1966, R/V PILLSBURY sta 362; ANSP 138470 (1, 40), 9°12.8'N, 76°27.1'W-9°11'N, 76°27.8'W, 62–66 m, 17 Jul 1966, R/V PILLSBURY sta 397. Golfo de Morrosquillo: UF 226502 (1, 76), 9°40'N, 76°01.5'W-9°41'N, 76°05.4'W, 45–55 m, 13 Jul 1966, R/V PILLSBURY sta 371. VENEZUELA: ANSP 138469 (1, 40), 11°08'N, 63°18'W-11°11'N, 17'W, 24–27 m, 19 Jul 1968, R/V PILLSBURY sta 712. ANSP 138472 (1, 76), 11°08.8'N, 62°46.1'W-11°12.9'N, 62°45.5'W, 48 m, 19 Jul 1968, R/V PILLSBURY sta 709.

Opistognathus whitehurstii (Longley)
Figures 8e, 30–33; Tables 2–5

Gnathypops whitehurstii Longley, 1931:385 (name only); Longley *in* Longley and Hildebrand, 1940: 262, fig. 19 (orig. descr.: Tortugas, Florida; holotype USNM 5689).

Opisthognathus whitehurstii. Longley and Hildebrand, 1941:242 (listed); Randall, 1967:789 (food habits).

Opisthognathus whitehursti. Böhlke, 1955:4, fig. 1c (description; comparison with *O. maxillosus*); Böhlke and Chaplin, 1957:353, fig. 1 (oral incubation); Böhlke and Thomas, 1961:511 (habits

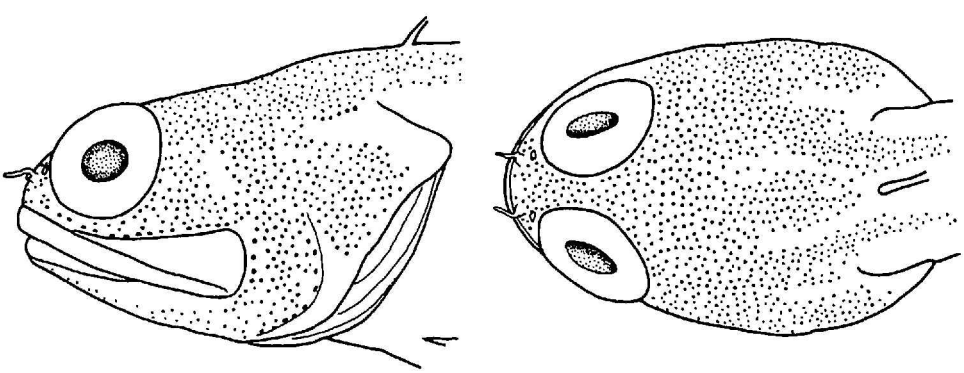

Figure 31. Physiognomy of head and cephalic sensory pores in *Opistognathus whitehurstii,* UF 101721, 48 mm SL, male, Florida, Broward Co.

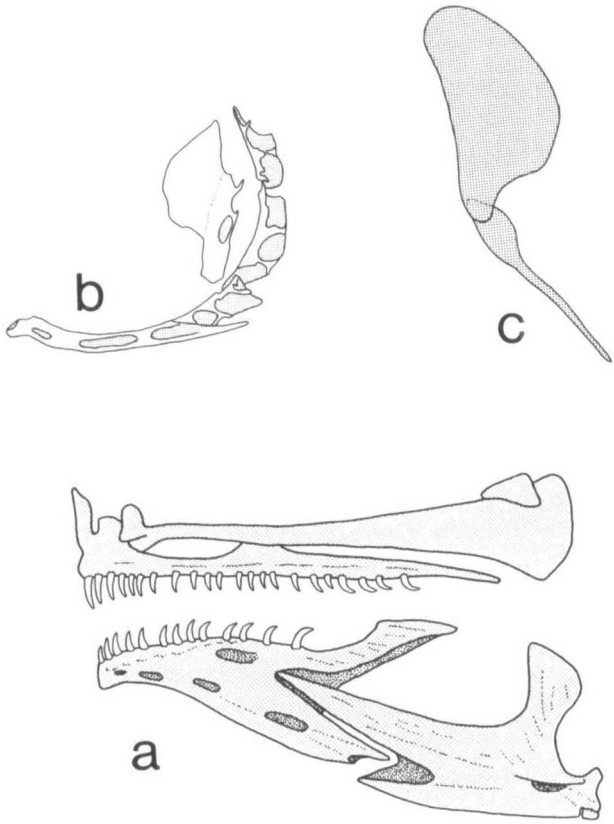

Figure 32. Selected bones in lateral views of *Opistognathus whitehurstii,* ANSP 78838, 56.2 mm SL: a, upper and lower jaws; b, infraorbital bones (3rd infraorbital also in rotated dorsal view); c, dorsal and ventral postcleithra.

and habitat); Birdsong and Emery, 1968:191 (British Honduras); Zeiller, 1975:105, Fig. 227 (color photograph).

Opistognathus whitehurstii. Randall, 1968:170, fig. 193 (description).

Opistognathus whitehursti. Böhlke and Chaplin, 1968:486, unnumbered figs. (description; color photograph; habits); Starck, 1968:28 (Alligator Reef, Florida); Bailey et al., 1970:47 (common

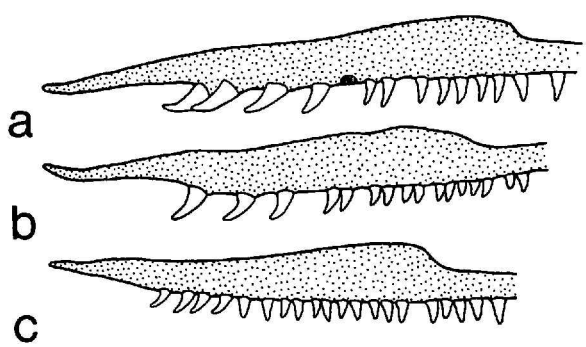

Figure 33. Right premaxillae (posterior to left) of *Opistognathus whitehurstii* showing sexual dimorphism of posteriormost teeth: a, male, 56.5 mm SL, UF 219716; b, male, 47.7 mm SL, UF 16175; c, female, 51.4 mm SL, UF 219716.

name "dusky jawfish"); Robins et al., 1980:50 (common name "dusky jawfish"); Gilmore et al., 1981:21 (listed from offshore reefs adjacent to Indian River Lagoon, Florida); Acero P. et al. 1984:76, fig. 10 (description; Colombia); Noyes, 1987:72, unnumbered figs. (color photograph; behavior and aquarium maintance); Robins and Ray, 1986:217, color pl. 43 (brief descr.); Hess, 1993:813 (male mouth brooding; reproductive biology); Humann, 1994:286, unnumbered color pl. (brief diagnosis).

Upsilonognathus chaplini Fowler, 1946:5, unnumbered fig. (orig. descr.: Bahamas, Nassau, north beach of Hog Island; holotype ANSP 71727); Böhlke, 1955:1 (synonymized with *O. whitehurstii*).

Gnathypops maxillosa (*non* Poey). Jordan and Gilbert, 1882:942 (description); Jordan and Evermann, 1898:2284, fig. 801 (compiled).

Diagnosis.—A species of *Opistognathus* with the following combination of characters: anterior nostril consisting of short tube with a simple slender cirrus on posterior rim; posterior end of maxilla rigid, not produced as a thin flexible lamina; premaxilla with one row of teeth; mature males (only) with posteriormost 2–4 premaxillary teeth usually stouter and more strongly hooked than adjacent teeth (Figs. 33a–b); area surrounding esophageal opening immaculate; body with 42–54 oblique scale rows in longitudinal series; caudal vertebrae typically 17.

Description.—Dorsal fin X–XII (typically XI), 13–15=24–26 total. Anal fin III, 12–14 (typically 13). Pectoral-fin rays 17–20 (typically 18 or 19). Caudal fin: procurrent rays 4–5+3–4; segmented rays 8 + 8, middle 12 or 13 (usually 12) branched, total elements 23–25; hypural 5 present or absent. Vertebrae 10 (11 in one of 138) + 16–18 (typically 17), last pleural rib on vertebra 10, epineurals 11–15. Supraneural bones absent. Gill rakers (in adults number not increasing with increase in SL) 8–11 + 16–21= 24–32.

Scales absent from head, nape, pectoral-fin base and breast; belly completely scaled and sides fully scaled except for area anteriorly above lateral line. Body with 42–54 oblique scale rows in longitudinal series. Lateral-line terminus below verticals between last spine and 4th segmented dorsal-fin ray. Anterior lateral-line pores relatively numerous and arranged in branched series along lateral-line tubes, all of which are embedded in skin. Mandibulo-preopercular pore positions all consisting of multiple pore series, except first two mandibular pore positions occupied by simple pores. Infraorbital pore positions consisting of multiple series which extend onto cheeks. Nape nearly to completely pored (Fig. 31).

Anterior nostril positioned closer to posterior nostril than to dorsal margin of upper lip, and with a simple, slender posterior cirrus which usually reaches anterior margin of orbit when depressed; height of cirrus 2.0–3.5 times maximum diameter of posterior nostril. Dorsal fin moderately low anteriorly, with posterior rays slightly longer; profile relatively uniform without noticeable change in fin height at junction of spinous and segmented rays. Dorsal-fin spines stiff and straight with pungent tips; the skin covered tips usually with pale, slightly swollen fleshy tabs. Segmented dorsal- and anal-fin rays all typically branched distally. Outermost segmented pelvic-fin ray not tightly bound to adjacent ray, interradial membrane strongly incised distally; tip of depressed pelvic fin in front of anal-fin origin. Upper margin of subopercle with a narrow truncated flap (Fig. 8e), externally sloping downward and rounded posterodorsally (Fig. 31), not consisting of a broad, fan-like, truncated flap; dorsalmost spine of opercle noticeably elongate ; posterior margin of preopercle distinct, with a well-developed groove dorsally. No papillae on inner surface of lips. Fifth cranial nerve passes over A1β section of adductor mandibulae muscle.

Upper jaw not sexually dimorphic, extending 0.5–1.0 eye diameters behind orbit; posterior end of maxilla rigid and truncate, without a thin flexible lamina; supramaxilla relatively small and terminally positioned. Coronoid (ascending) process of articular slightly tilted backward and somewhat club-shaped with an-

terodorsal end bluntly pointed and posteroventral end bluntly rounded. Premaxilla with single row of teeth, largest anteriorly becoming smaller and more closely spaced posteriorly except in mature males posteriormost 3 or 4 teeth stouter and more strongly hooked than adjacent teeth (Figs. 33a–b). Dentary anteriorly with two rows of teeth, innermost smaller and slanted backwards; laterally teeth uniserial and larger than anterior teeth, posterior teeth of males larger and more strongly hooked than others. Vomer with 1 or 2 (rarely 3) large teeth. Infraorbital bones tubular, with numerous openings for sensory canals (Fig. 32b); third infraorbital with a wide suborbital shelf. Postcleithra closely attached (Fig. 32c); dorsal postcleithrum an irregular elongate oval, narrowest ventrally where it overlaps head of ventral postcleithrum; ventral postcleithrum club-shaped, broadest dorsally and with a pointed ventral end.

Selected measurements of 94 specimens (38.5–66.2 mm SL) as percent SL, sample sizes in parentheses: head length 30.6–41.6 (88); postorbital head length 18.9–24.7 (52); orbit diameter 9.6–13.1 (87); upper jaw 19.6–26.1 (96); pelvic fin length 16.0–25.7 (68); caudal fin length 18.7–27.4 (67). Selected measurements as percent HL: postorbital head length 49.3–67.2 (52); orbit diameter 27.6–37.7 (87); upper jaw length 55.0–68.1 (88); postorbital jaw length 15.0–29.9 (53).

Coloration.—Body and fins various shades of brown; head usually variegated and with scattered dark speckles, branchiostegal membranes dark in mature males, and sides often with somewhat regular pattern of darker pigmented scales. Dorsal fin with pale basal area extending entire length of fin except six evenly spaced dark blotches which extend slightly onto dorsum usually present; spinous dorsal fin otherwise uniformly brown except for pale spine tips and a dark blotch or spot between spines 2–4 or 5 which is typically present in juveniles but is often faint or absent in adults; soft dorsal fin with several rows of dark spots. Anal fin pale proximal margin, darker above with rows or dark spots. Caudal fin with pair of pale basicaudal spots followed by rows of dark spots giving fin banded appearance; pelvic fins mostly uniform brown and pectoral fins immaculate. Inner corner of maxilla and adjacent membranes with brownish blotch, best developed in males; no dark buccal pigmentation. In life, dark spot in spinous dorsal fin bluish; head and body mottled with dark brown and flecked with blackish; caudal and soft dorsal fins mostly yellow with rows of dark brown to black spots.

Etymology.—Named for Dr. D. D. Whitehurst who collected the holotype. The recommended common name (Robins et al., 1991) is dusky jawfish.

Distribution (Fig. 34).—Bahamas, southeastern Florida, including the Florida Keys (but absent from the Gulf of Mexico) and throughout the Caribbean to northern South America, in depths of about 0.3 to 20 m, except for two trawl collections from 46–61 and 47.5 meters, respectively. One specimen (CAS 30624) from the San Blas Archipelago, collected by hand, was found within a "green cylindrical sponge."

Material Examined.—272 specimens, 19–65.3 mm SL. FLORIDA: ANSP 138598 (1, 65); UF 7005 (4, 29–50); UF 32421 (1, 43); UF 100051 (1, 43); UF 100052 (1, 41); UF 101720 (1, 50); UF 101721 (3, 45–48); ; UF 11870 (1, 22); UF 16175 (7, 26–51); UF 201516 (2, 45–50); UF 202900 (10, 47–53); UF 203199 (2, 23–66); UF 203621 (1, 40); UF 204564 (1, 42); UF 208439 (1, 51); UF 209254 (9, 19–47); UF 222560 (1, 44); UF 228474 (1, 59); UF 218999 (3, 40–42); UMMZ 199014 (2, 16–17); UMMZ 199010 (1, 53); UF 202203 (1, 37); UF 206411 (2, 36–46); UF 208683 (3, 46–55); UF 211924 (8, 29–47); UF 219648; UF 219716 (5, 46–57); UF 220218 (8, 23–47); UMMZ 199009 (9, 25–41); UMMZ 199012; USNM 5689 (57.3, holotype of *Gnathypops whitehurstii*); USNM 5866 (2, 57.6–58.8). BAHAMAS: AMNH 23436 (1, 34); AMNH 24843 (1, 49); AMNH 25941 (1, 30); AMNH 28731 (1, 42); AMNH 30035 (1, 37); AMNH 30174 (1, 34); ANSP 71727 (45.2, holotype of *Upsilonognathus chaplini*); ANSP 73256 (1, 50); ANSP 75164 (1, 55); ANSP 78830 (3, 33–59.5); ANSP

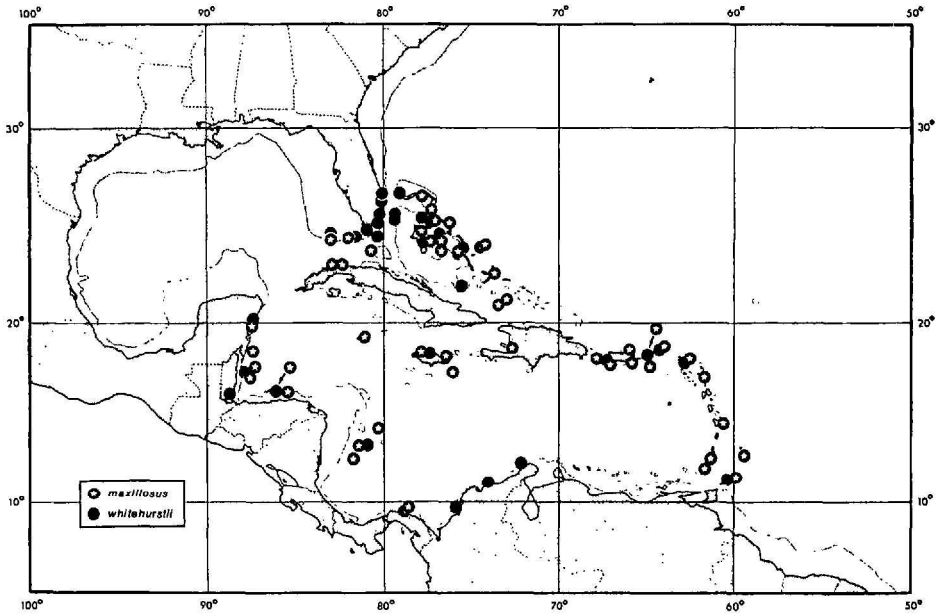

Figure 34. Distributions of *Opistognathus whitehurstii* and *O. maxillosus*.

78831 (1, 63); ANSP 78832 (5, 46–56); ANSP 78833 (2, 53–57); ANSP 78834 (1, 49); ANSP 78836 (2, 53–58); ANSP 78837 (1, 61); ANSP 78838 (14, 45–59.5, including 6 C&S); ANSP 101233 (1, 20); ANSP 111448 (5, 28–57); ANSP 116335 (5, 33–42); ANSP 138117 (1, 19); UF 16089 (1, 59); UF 211379 (1, 49); UF 212614 (2, 27–43); UF 228475 (1, 54); UF 232926 (4, 35–53). JAMAICA: ANSP 138452 (1, 51). PUERTO RICO: UPRM 2582 (6, 34–52); UPRM 3253 (1, 44). VIRGIN IS.: ANSP 96926 (1, 30); UF 209026 (1, 37). ST. BARTHELEMY: ANSP 121905 (1, 22); ANSP 121953 (1, 27). TOBAGO: USNM 317015 (1, 36); USNM 317032 (2, 31–32); USNM 320837 (3, 18–36). COLOMBIA: ANSP 138517 (1, 39); MCZ 47488 (1, 45); MCZ 47491 (1, 50); MCZ 47492 (1, 60); USNM 217808 (2, 39–65); USNM 217809 (3, 28–61). PANAMA: CAS 30624 (1, 45); CAS 30625 (1, 51); CAS 40290 (1, 27); SIO 70-376 (1, 20); SIO 71-56 (1, 49); TU 79306 (3, 36–40). PROVIDENCIA IS.: UF 28811 (1, 48); UF 23448 (1, 41). HONDURAS: ANSP 120992 (2, 16–41); FMNH 84499 (1, 49). BELIZE: FMNH 82579 (3, 29–42); FMNH 82580 (7, 34–57); UF 209839 (1, 33); UF 209860 (1, 29). MEXICO: ANSP 126672 (5, 22–38).

Opistognathus maxillosus Poey
Figures 8f, 35–37; Tables 2–5

Opisthognathus maxillosus Poey, 1860:286 (orig. descr.: Cuba; holotype presumably lost); Jordan and Gilbert, 1882:942 (*O. maxillosus* designated type-specimen of *Gnathypops* Gill); Böhlke,

Figure 35. *Opistognathus maxillosus*, ANSP 141705, 71.3 mm SL, male, Puerto Rico, Laurel Reef.

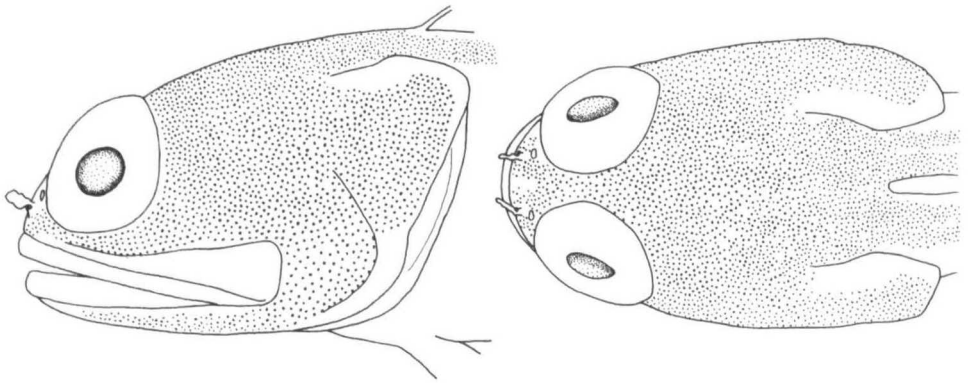

Figure 36. Physiognomy of head and cephalic sensory pores in *Opistognathus maxillosus*, UF 231167, 62 mm SL, male, Virgin Is., St. Croix.

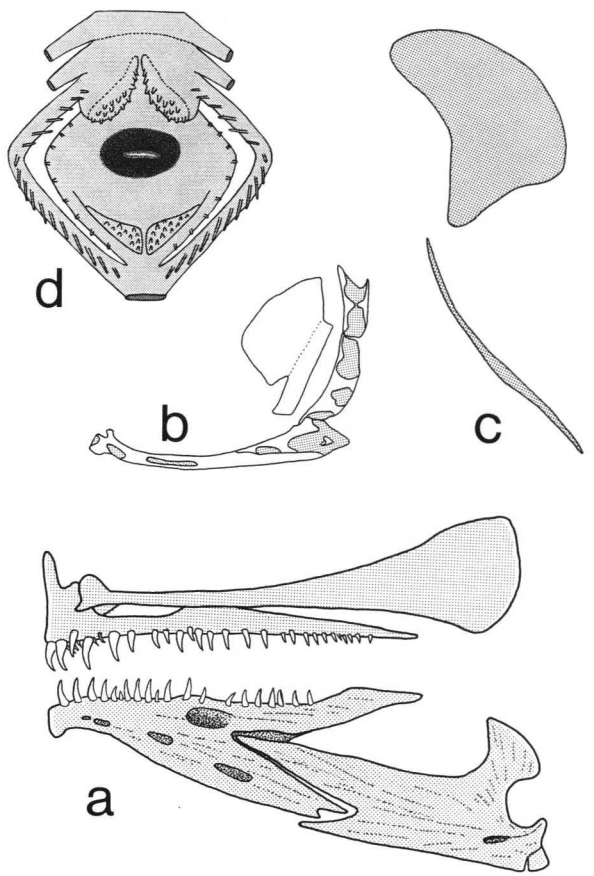

Figure 37. Selected bones in lateral views of *Opistognathus maxillosus*, ANSP 115095, 61.7 mm SL: a, upper and lower jaws; b, infraorbital bones (3rd infraorbital also in rotated dorsal view); c, dorsal and ventral postcleithra; d, semidiagramatic drawing of buccal pigmentation.

1955:2, figs. 1a–b (description; comparison with *O. whitehurstii*); Böhlke and Chaplin, 1957:353 (oral incubation); Duarte-Bello, 1959:106 (listed); Böhlke and Thomas, 1961:511 (habits and habitat); Caldwell, 1966:71 (Jamaican records); Randall, 1967:789 (food habits); Birdsong and Emery, 1968:190 (Nicaragua and Yucatan records).

Opistognathus maxillosus. Böhlke and Chaplin, 1968:488, unnumbered fig. (description; habits); Randall, 1968:169, fig. 192 (description); Bailey et al., 1970:47 (common name "mottled jawfish"); Walls, 1975:296, unnumbered fig. (description); Robins et al., 1980:50 (common name "mottled jawfish"); Robins and Ray, 1986:217, color pl. 43 (brief descr.); Hess, 1993:809 (male mouth brooding; reproductive biology).

Gnathypops maxillosus. Gill, 1862:241 (genus *Gnathypops* proposed for *O. maxillosus* and *macrops*).

Gnathypops maxillosa. Jordan and Evermann, 1898:2284 (description); Jordan, Evermann and Clark, 1930:452 (listed).

Diagnosis.—A species of *Opistognathus* with the following combination of characters: anterior nostril a short tube with broadly rounded or palmate cirrus on posterior rim; posterior end of maxilla rigid, not produced as a thin flexible lamina; supramaxilla absent; subopercle with a broad, fan-like, truncated flap (Figs. 8f, 36); buccal pigmentation consisting of a small dark area surrounding esophageal opening; body with 69–85 oblique scale rows in longitudinal series; caudal vertebrae typically 18.

Description.—Dorsal fin X–XI (rarely X), 14–16 = 24–27 total. Anal fin II or III (rarely III), 14–16 (usually 15). Pectoral-fin rays 19–22. Vertebrae: 10 (11 in three of 164) + 17–19 (typically 18), last pleural rib on vertebra 10, epineurals 12–17. Supraneural bones absent. Caudal fin: procurrent rays 4–5+4–5; segmented rays 8 + 8, middle 12 or 13 branched, total elements 24–26; hypural 5 absent. Gill rakers (in adults number not increasing with increase in SL) 8–11 + 17–22 = 25–33.

Scales absent from head, nape, pectoral-fin base and breast; belly completely scaled and sides fully scaled except for area above lateral line anteriorly. Body with 69–85 oblique scale rows in longitudinal series. Lateral-line terminus below verticals between 3rd to 7th segmented dorsal-fin ray. Anterior lateral-line pores relatively numerous and arranged in branched series along lateral-line tubes, all of which are embedded in skin. Mandibulo-preopercular pore positions all consisting of multiple pore series, except first two mandibular pore positions occupied by simple pores. Infraorbital pore positions consisting of multiple series which extend onto cheeks. Nape nearly to completely pored (Fig. 36).

Anterior nostril positioned closer to posterior nostril than to dorsal margin of upper lip, and with a broadly rounded or palmate cirrus which usually reaches anterior margin of orbit when depressed; height of cirrus 1.0–2.0 times maximum diameter of posterior nostril. Dorsal fin moderately low anteriorly, with posterior rays slightly longer; profile relatively uniform without noticeable change in fin height at junction of spinous and segmented rays. Dorsal-fin spines stiff and straight with pungent tips; the skin covered tips usually with pale, slightly swollen fleshy tabs. Segmented dorsal- and anal-fin rays all typically branched distally. Outermost segmented pelvic-fin ray not tightly bound to adjacent ray, interradial membrane strongly incised distally; tip of depressed pelvic fin in front of anal-fin origin. Upper margin of subopercle consisting of a broad, truncated flap (Fig. 8f), externally fan-like posterodorsally (Fig. 36); dorsalmost spine of opercle not noticeably elongate (Fig. 8f); posterior margin of preopercle distinct, with a well-developed groove dorsally. No papillae on inner surface of lips. Fifth cranial nerve passes over A1β section of adductor mandibulae muscle.

Upper jaw not sexually dimorphic, extending 0.8–1.4 eye diameters behind orbit; posterior end of maxilla rigid and truncate, without a thin flexible lamina;

supramaxilla absent. Coronoid (ascending) process of articular slightly tilted backward and somewhat club-shaped with anterodorsal end bluntly pointed and posteroventral end bluntly rounded (Figs. 37a). Premaxilla anteriorly with an outer row of stout teeth and an inner row of smaller, backward slanting teeth, some nearly horizontal; laterally teeth uniserial and becoming progressively smaller and more closely spaced. Dentary anteriorly with an outer row of stout teeth and an inner row of smaller, backward slanting teeth; laterally teeth uniserial and smaller but not progessively so. Vomer with 1 or 2 (rarely 3) large teeth. Infraorbital bones tubular, with numerous openings for sensory canals (Fig. 37b); third infraorbital with a wide suborbital shelf. Postcleithra consisting of two well separated bones; dorsal postcleithrum an irregular elongate oval, narrowest ventrally, ventral postcleithrum rod-shaped with pointed ends (Fig. 37c).

Selected measurements of 42 specimens (46.2–124.7 mm SL) as percent SL, sample sizes in parentheses: head length 33.4–38.1 (42); postorbital head length 21.0–24.4 (22); orbit diameter 9.0–12.4 (41); upper jaw 21.0–25.0 (42); pelvic fin length 16.7–22.9 (37); caudal fin length 20.3–25.4 (37). Selected measurements as percent HL: postorbital head length 57.7–66.6 (22); orbit diameter 25.3–34.2 (41); upper jaw length 59.8–69.2 (42); postorbital jaw length 22.9–35.5 (19).

Coloration.—Head usually marbled and variegated, and jaws banded; body brown with scattered small, dark spots, and typically with several lateral rows of large pale spots as in Figure 35. Dorsal fin with 5 or 6 brown to blackish blotches, anteriormost blotch sometimes diffuse or absent and one between 6th to 10th spine often darkest and best defined; spinous dorsal fin otherwise mostly dusky except for pale spine tips. Soft dorsal and anal fins mostly dusky with rows of small pale spots; caudal fin with a conspicuous pair of pale basicaudal spots separated by dark median area, remainder of fin pale except rauys usually with rows of dark spots giving fin a banded appearance. Pelvic fins mostly dark and pale pectoral fin fins with dark speckles proximally. Inner corner of maxilla and adjacent membranes with brownish blotch and dark pigment completely surrounding esophageal opening as in Figure 37d.

In life, pale areas are yellowish and dark markings are various shades of brown to black.

Etymology.—The trival name is derived from the Latin *maxilla* (jaw) and *osus* (having the nature of, usually in fullness or abundance). The recommended common name (Robins et al. 1991) is mottled jawfish.

Remarks.—The reason for not placing Poey's name in parentheses when using the combination *Opistognathus maxillosus* as done by Robins et al. (1991) is explained under "Remarks" in the account of *O. macrognathus.*

Distribution (Fig. 34).—As inshore species known from the Bahamas, Florida Keys and throughout most of the Caribbean to Panama and Tobago, but apparently absent from northern South America or the Gulf of Mexico, in depths of about 0.3 to 5–12 (deepest trawl collection) m.

Material Examined.—406 specimens, 11–125 mm SL. FLORIDA: UF 211734 (1, 110); UF 220139 (1, 93); USNM 117031 (10, 53–119), 1940. CUBA: MCZ 12512 (1, 90); CAS-SU 54177 (2, 64–74); USNM 82508 (1, 64); USNM 82509 (1, 57). BAHAMAS: AMNH 20625 (1, 76); AMNH 21230 (1, 79); AMNH 21323 (10, 32–103); AMNH 23130 (2, 64–103); AMNH 21365 (4, 35–105); AMNH 21479 (8, 32–86); AMNH 23187 (1, 65); AMNH 23435 (2, 55–60); AMNH 23603 (1, 84); AMNH 24797 (6, 12–13); AMNH 24841 (6, 13–96); AMNH 25870 (1, 83); AMNH 28841 (1, 68); AMNH 29936 (99, 11–13); AMNH 31995 (17, 13–97); AMNH 34993 (1, 13); AMNH 39186 (1, 12); ANSP 78821 (8, 37–125); ANSP 78827 (19, 12–16.5); ANSP 79157 (1, 80); ANSP 79158 (1, 75); ANSP

101182 (1, 99); ANSP 101183 (5, 32–104); ANSP 101181 (4, 30–98); ANSP 101184 (1, 60); ANSP 101236 (3, 12–15); ANSP 115095 (8, 47–84, including 4 C&S); ANSP 116334 (1, 60); ANSP 119796 (10, 23–76); ANSP 126795 (16, 61–115); ANSP 134575 (1, 47); UF 14352 (1, 32); UF 17242 (1, 38); UF 201170 (2, 91–107); UF 228476 (10, 75–100). JAMAICA: ANSP 138456 (1, 95); LACM 5798 (2, 43–47); LACM 5799 (6, 26–39); LACM 5800 (1, 108); LACM 5801 (1, 92). GRAND CAYMAN IS.: ANSP 102304 (1, 93); ANSP 104914 (2, 80–110); ANSP 105076 (1, 82); ANSP 105107 (1, 96); ANSP 134241 (3, 54–86); UF 15682 (2, 85–92). HAITI: ANSP 120976 (1, 94); ANSP 120988 (1, 91); UF 206177 (1, 72); UF 206240 (2, 69–94). MONA IS.: ANSP 138833 (1, 88). PUERTO RICO: ANSP 141705 (2, 71–79); UF 58080 (1, 92); UF 58091 (1, 93); UMMZ 172852 (1, 112); UMMZ 172861 (1, 125); USNM 147645 (2, 97–99); USNM 216402 (1, 31); UPRM 1101 (2, 27–91). VIRGIN IS.: ANSP 141705 (2, 71–79); UF 205055 (5, 23–99); UF 205273 (4, 10–53); UF 205472 (1, 113); UF 211098 (1, 28). ST. CROIX: UF 231167 (4, 40–62). ST. BARTHELEMY: ANSP 121669 (1, 56); ANSP 121891 (1, 40). ANTIGUA: UF 11341 (1, 29); UF 11941 (1, 25). ST. LUCIA: ANSP 138455 (3, 47–83). BARBADOS: ANSP 73255 (1, 63); ANSP 88718 (7, 25–89); ANSP 141705 (2, 71–79); ZMB 2013 (1, 77). GRENADINES: ANSP 120993 (1, 47); ANSP 134576 (1, 93); ANSP 120987 (2, 47–100). GRENADA: ANSP 113912 (3, 30–90); ANSP 119001 (1, 56). TOBAGO: USNM 318605 (1, 66). PANAMA: CAS 30628 (6, 55–106); SIO 71–270 (1, 84); SIO 71–274 (2, 91–102); TU 79305 (11, 56–106). NICARAGUA: UF 228906 (2, 78–106). PROVIDENCIA IS.: UF 228818 (4, 35–65). SERRANA BANK: ANSP 134577 (6, 36–106); USNM 217804 (8, 40–105). HONDURAS: FMNH 84498 (1, 72); UF 231156 (2, 91–121). BELIZE: FMNH 77746 (1, 67); FMNH 77866 (1, 96); FMNH 82576 (4, 56–101); FMNH 82581 (1, 79); UF 209283 (2, 12–16); UF 211463 (1, 43). YUCATAN: ANSP 138116 (1, 24); UF 209300 (1, 30).

ACKNOWLEDGMENTS

I thank all the curators and collection managers of the various institutions cited in this paper for the loan of specimens and other courtesies. I especially thank E. B. Böhlke and W. G. Saul for curation of many jawfish specimens and assistance with radiographs, and N. M. Feinberg for expediting the loan of a specimen of *O. nothus* on short notice. A. M. Foster assisted with analysis of data and S. J. Walsh read an early draft of the manuscript and provided much help with Figures 15–18 and 28–29. The manuscript also benefited from reviews by R. D. Mooi and V. G. Springer. This research was supported in part by NSF Grant DEB 78-12891.

LITERATURE CITED

Acero P., A., J. Garzón F., and F. Köster. 1984. Lista de los peces oseos conocidos de los arrecifes del Caribe Colombiano, incluyendo 31 nuevos registros y descripciones. Caldasia 14 (66): 37–84.

Allen G. R. and D. R. Robertson. 1991. Quatre espèces nouvelles d'Opisthognathidae (jawfishes) du Pacifique oriental tropical. Revue Fr. Aquariol. 18: 47–52.

Anderson, W. D., Jr. and W. F. Smith-Vaniz. 1976. Sexual dimorphism in the jawfish *Opistognathus melachasme*. Copeia 1976: 202–204.

Bailey, R. M., J. E. Fitch, E. S. Herald, E. A. Lachner, C. C. Lindsey, C. R. Robins and W. B. Scott. 1970. A list of common and scientific names of fishes from the United States and Canada (third edition). American Fish. Soc. Spec. Publ. 6. 150 p.

Birdsong, R. S. and A. R. Emery. 1968. New records of fishes from the western Caribbean. Quart. J. Fla. Acad. Sci. 30: 187–196.

Böhlke, J. E. 1955. On the Bahaman fishes of the family Opisthognathidae. Notulae naturae, Acad. Nat. Sci. Phila. (281). 6 p.

——— and C. C. G. Chaplin. 1957. Oral incubation in Bahaman jawfishes *Opisthognathus whitehursti* and *O. maxillosus*. Science 125: 353.

——— and ———. 1968. Fishes of the Bahamas and adjacent tropical waters. Livingston Publishing Co., Wynnewood, Pennsylvania. 771 p.

——— and L. P. Thomas. 1961. Notes on the west Atlantic jawfishes, *Opisthognathus aurifrons, O. lonchurus* and *Gnathypops bermudezi*. Bull. Mar. Sci. 11: 503–516.

Briggs, J. C. 1961. Emendated generic names in Berg's classification of fishes. Copeia 1961: 161–166.

Caldwell, D. K. 1966. Marine and freshwater fishes of Jamaica. Bull. Inst. Jamaica, Sci. Ser 17: 1–120.

Colin, P. L. 1972. Daily activity patterns and effects of environmental conditions on the behavior of the yellowhead jawfish, *Opistognathus aurifrons*, with notes on its ecology. Zoologica 57: 137–169.

Cervigón, F. 1966. Los peces marinos de Venezuela. Fundacion La Salle de Ciencias Naturales, Monograph 12 (2): 441–951.

———. 1994. Los peces marinos de Venezuela. Fundación Científica Los Roques, Caracas. Vol. 3. 295 p.

Cuvier, G. and A. Valenciennes. 1836. Histoire naturelle des Poissons. Paris Vol. 11: 506 p., 307–343 pls.

Duarte-Bello, P. P. 1959. Catalogo de Peces Cubanos. Universidad Catolica de Santo Tomas de Villanueva, monografia 6. 208 p.

Fowler, H. W. 1941. A list of the fishes known from the coast of Brazil. Arquivos de Zoologia do Estado de Sao Paulo 3 (6): 115–184.

———. 1946. Notes on Bahama fishes with a description of a new jawfish (Opisthognathidae). Notulae Naturae, Acad. Nat. Sci. Phila. 181: 8 p.

Gilmore, R. G., C. J. Donohoe, D. W. Cooke and D. J. Herrema. 1981. Fishes of the Indian River Lagoon and adjacent waters, Florida. Harbor Branch Foundation, Inc. Tech. Rep. 41: 36 p.

Gill, T. N. 1862. Remarks on the relations of the genera and other groups of Cuban fishes. Proc. Acad. Nat. Sci. Phila. 14: 235–242.

Goode, G. B. and T. H. Bean. 1882. Descriptions of twenty-five new species of fish from the southern United States, and three new genera, *Letharcus, Ioglossus,* and *Chriodorus.* Proc. U. S. Natl. Mus.5 (297): 412–437.

Goodson, G. 1976. The many splendored fishes of the Atlantic coast including the fishes of the Gulf of Mexico, Florida, Bermuda, the Bahamas and the Caribbean. Marquest Colorguide Books, Palos Verdes Estates, California. 201 p.

Günther, A. 1860. Catalogue of the Acanthopterygian fishes in the collection of the British Museum, London Vol. 2: 527 p.

Hess, H. C. 1993. Male mouthbrooding in jawfishes (Opistognathidae): constraints on polygyny. Bull. Mar. Sci. 52: 806–818.

Howell Rivero, L. 1936. Some new, rare and little-known fishes from Cuba. Proc. Boston Soc. Nat. Hist. 41 (4): 41–76.

Hubbs, C. L. and K. F. Lagler. 1958. Fishes of the Great Lakes Region. Cranbrook Inst. Sci. Bull. 26, Bloomfield Hills, Mich.: 135 p.

Humann, P. 1994. Reef fish identification: Florida, Caribbean, Bahamas. 2nd ed. New World Publications, Jacksonville, Florida. 424 p.

Instituto Nacional de Pesca. 1976. Catálogo de peces marinos Mexicanos. Secretaría de Industria y Comercio, Subsecretaría de Pesca. 462 p.

Jordan, D. S. and B.W. Evermann. 1898. The fishes of North and Middle America. Bull. U. S. Natl. Mus. 47 (3): i–xxiv + 2183a–3136.

——— and C. H. Gilbert. 1882. Synopsis of the fishes of North America. Bull. U. S. Natl. Mus. 16: 1–1018.

———, ———, and H. W. Clark. 1930. Check list of the fishes and fishlike vertebrates of North and middle America north of the northern boundary of Venezuela and Colombia. Rep. U. S. Comm. Fish. 1928 (2): 1–670.

Leviton, A. E., R. H. Gibbs Jr., E. Heal and C. E. Dawson. 1985. Standards in herpetology and ichthyology: Part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. Copeia 1985: 802–832.

Longley, W. H. 1931. Observations on Tortugas fishes. Carnegie Inst. Washington Yearbook 30: 385–386.

——— and S. F. Hildebrand. 1940. New genera and species of fishes from Tortugas, Florida. Pap. Tortugas Lab. 32 (24): 225–285.

——— and ———. 1941. Systematic catalogue of the fishes of Tortugas, Florida with observations on color, habits, and local distribution. Pap. Tortugas Lab. 34. 331 p.

Meek, S. E. and S. F. Hildebrand. 1928. The marine fishes of Panama. Field Mus. Nat. Hist. Publ. 249, Zool. Ser. 15 (3): 709–1045.

Menezes, N. A. and J. L. de Figueiredo. 1985. Manual de peixes marinhos do sudeste do Brasil. V. Teleostei (4), Museu de Zoologia, Universidade de Sao Paulo: 1–105.

Noyes, J. C. 1987. The dusky jawfish *Opistognathus.* Freshwater Mar. Aquarium 10 (8): 72–73.

Palacio, F. J. 1974. Peces colectados en el Caribe Colombiano por la Universidad de Miami. Boletin del Museo del Mar 6: 1–137.

Pinto, S. Y. 1970. Observacoes ictiologicas. III. Sobre *Opisthognathus cuvieri* Valenciennes, 1836 (Actinopterygi, Perciformes, Opisthognathidae). Atlas de Sociedad de Biologia do Rio de Janeiro. 13 (1/2): 3–4.

Poey, F. 1860. Poissons de Cuba *in* Memorias sobre la historia natural de la isla de Cuba, acompanados de sumarios Latinos y extractos en Francés 2: 115–356.

Randall, J. E. 1967. Food habits of reef fishes of the West Indies. Stud. Trop. Oceanogr. 5: 655–847.

———. 1968. Caribbean Reef fishes. T.F.H. Publications, Inc., Jersey City, New Jersey. 318 p.

Ribeiro, A. de Miranda. 1915. Fauna Brasiliense, Peixes-phyosoclisti. Archivos do Museu Nacional do Rio de Janeiro, 17: 765 p. (not continuously paginated.)

Robins, C. R. and G. C. Ray. 1986. A field guide to Atlantic coast fishes of North America. Houghton Mifflin Co., Boston. 354 p.

———, R. M. Bailey, C. E. Bond, J. R. Brooker, E. A. Lachner, R. N. Lea and W. B. Scott. 1980. A list of common and scientific names of fishes from the United States and Canada (fourth edition). American Fish. Soc. Spec. Publ. 12. 174 p.

———, ———, ———, ———, ———, ———, and ———. 1991. Common and scientific names of fishes from the United States and Canada (fifth edition). American Fish. Soc. Spec. Publ. 20. 183 p.

Roux, C. 1964. Les Côtes du Brésil et l'Histoire Naturelle des Poissons de Cuvier et Valenciennes. Mélanges ichthyologiques. Mém. I.F.A.N. 68: 385–435.

———. 1973. Poissons teleosteens du plateau continental bresilien, resultats scientifiques des campagnes dela "Calypso" X. Ann. Inst. Océanogr. 49, fasc. supplementaire: 23–207.

Smith, G. B. 1976. Ecology and distribution of eastern Gulf of Mexico reef fishes. Florida Mar. Res. Publ. 19: 1–78.

Smith-Vaniz, W. F. 1972. Two new species of Caribbean deep-dwelling jawfishes (*Opistognathus*, Opistognathidae). Copeia 1972: 48–53.

——— and E. B. Böhlke. 1991. Additions to the ichthyofauna of the Bahama Islands, with comments on endemic species. Proc. Acad. Nat. Sci. Phila. 143: 193–206.

Starck, W. A. 1968. A list of fishes of Alligator Reef, Florida with comments on the nature of the Florida Reef fish fauna. Undersea Biol. 1: 3–40.

Thomson, D. A., L. T. Findley and A. N. Kerstitch. 1979. Reef fishes of the Sea of Cortez. John Wiley & Sons, New York. 302 p.

Thommasi, L. R. 1961. Sobre tres especies de peces marinos del litoral de San Pablo (Brasil). Neotropica 10 (31): 29–35.

Walls, J. G. 1975. Fishes of the northern Gulf of Mexico. T. F. H. Publications, Inc., Neptune City, New Jersey. 432 p.

Zeiller, W. 1975. Tropical marine fishes of southern Florida and the Bahama Islands. A. S. Barnes and Co., Inc., Cranbury, N.J. 127 p.

DATE ACCEPTED: October 3, 1996.

ADDRESS: *U. S. Geological Survey, Biological Resources Division, 7920 NW 71st Street, Gainesville, Florida 32653-3071.*